AN ANNOTATED BIBLIOGRAPHY OF CALIFORNIA CRETACEOUS MICROFOSSILS

INCLUDING A BRIEF HISTORY OF THE LITERATURE

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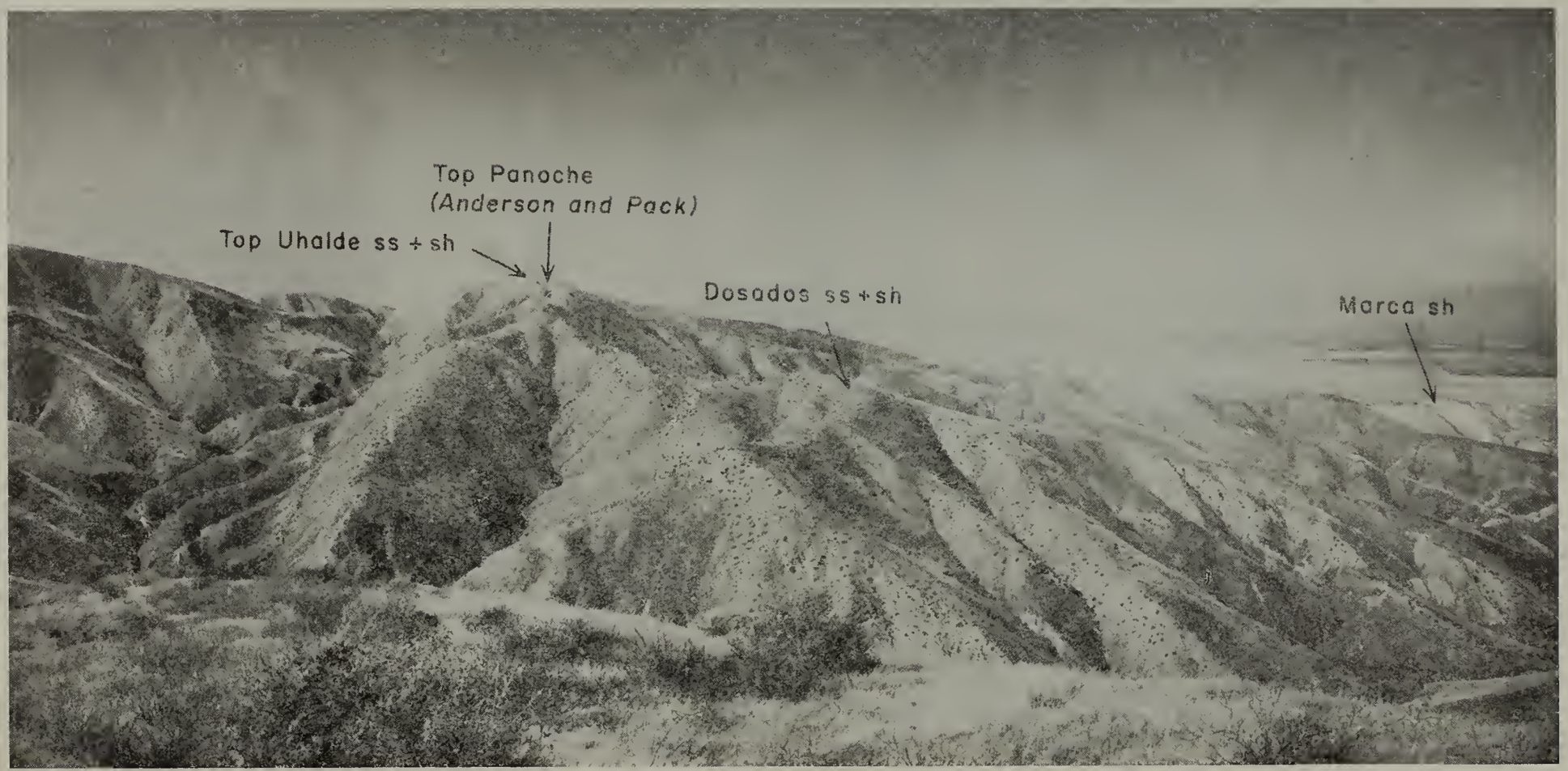
IN MEMORY OF

PROFESSOR HUBERT G. SCHENCK

1897-1960



FRONTISPIECE. Looking north in the Panoche Hills on the west side of the San Joaquin Valley at type section of the Upper Cretaceous Panoche and Moreno formations. Moreno Gulch in foreground from left to right. *Photo by M. B. Payne.*

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AN ANNOTATED BIBLIOGRAPHY OF CALIFORNIA CRETACEOUS MICROFOSSILS

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By JOSEPH J. GRAHAM

California Cretaceous strata totaling some 50,000 feet in thickness have been investigated for over a century. Because of industrial requirements, some of these rocks have been studied and restudied. This research, however, has not always been systematic, co-ordinated or integrated. Workers have not yet set up a usable time-stratigraphic classification. Some stratigraphers believe such a classification should be founded on microfossils and synchronized with the ammonite scale, with careful attention to stratigraphic control. That a time-stratigraphic classification of this nature is urgently needed becomes more and more apparent. It is the thought of the writer that for the biostratigrapher to work toward such a goal in California some sort of a synopsis is needed—perhaps one in the form of an annotated bibliography—of what has been published on the composition, stratigraphic occurrence, and ecology of the various micro-faunal and floral assemblages of the Cretaceous System.

When some of the early papers on Cretaceous stratigraphy of California were printed, the divisions of the system were called Knoxville, Horsetown, and Chico. The last, for example, was practically synonymous with "Upper Cretaceous." In recent years Alvin A. Almgren, Frank M. Anderson, Orville L. Bandy, Georges Deflandre, J. Wyatt Durham, Martin F. Glaessner, Ralph W. Imlay, David L. Jones, Klaus Küpper, Alfred R. Loeblich, Jr. and Helen Tappan, Tatsuro Matsumoto, Siemon W. Muller, S. E. Nakkady, Rudolf Noth, Willis P. Popenoe, Hubert G. Schenck, Hans E. Thalmann, and Ernest F. Trujillo, among others, have demonstrated the value of using the European standard of the Cretaceous in California. The reader accordingly will find references to Cenomanian, Turonian, Senonian, Maastrichtian in the following pages; that is to say, to world-wide time-stratigraphic terms as well as to local rock-stratigraphic (formation, member, etc.) units. I might add that a colleague of mine, Professor E. L. Packard, many years ago had the time-stratigraphic concept in mind but did not use some of the technical terms that one finds today in professional reports. The Franciscan (formation? group? series?) is especially troublesome because so many writers call it Jurassic. By typotopology (the science of type localities) the Calera limestone at the base of the Franciscan is on foraminiferal evidence lower Upper Cretaceous (Cenomanian) in age and other parts of the "series" in the San Francisco Bay area on the basis of ammonites are Cretaceous also.

It is hoped that this bibliography—covering 180 references—adequately summarizes the vast amount of research that has already been published on the micropaleontology of the Cretaceous System in California and will be of some aid in suggesting problems that will add to our understanding of this portion of the geologic column. Few papers are included that give the synonymies of the various species; other biblographies, such as those by Hans E. Thalmann, cover this field to some extent, and the taxa listed therein should supply the systematist with the necessary information.

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Acknowledgments. The writer wishes to thank Dana K. Clark of Campbell, California, for suggesting several bibliographic references; also the Shell Companies Foundation, Inc. and the California Division of Mines for support in the preparation and publication of this bibliography through grants-in-aid. Thanks are also extended to Marianne U. Thalmann, Stanford, California, for typing the manuscript.

CALIFORNIA CRETACEOUS MICROFOSSILS—A BRIEF HISTORY OF THE LITERATURE

In the following review of the many publications on Cretaceous microfossils from California, a tripartite division is used solely for ease of narration:

I. 1891-1926: Observation—Recording Period
II. 1927-1941: Hanna-Moreno Period
III. 1942-1960: Thalmann-Goudkoff/Time-Stratigraphic Period

Period I (1891-1926)

The initial 36-year period is concerned mainly with the discovery of microfossils—Foraminifera and Radiolaria—in the Cretaceous system of California and the cataloguing of the occurrence of these protozoans in various types of rocks. The earliest record that has come to my attention is by H. W. Turner, who stated in his discussion of the geology of the Mt. Diablo region (1891) that Foraminifera had been observed in beds he was referring to the Chico formation. He gave no generic or specific determination, nor did he list the stratigraphic position or the locality where these protozoans were found. Three years later (1894), G. J. Hinde described and illustrated some poorly preserved Radiolaria from cherts on Angel Island in San Francisco Bay and also from Buriburi Ridge in San Mateo County. These appeared to him to be similar to forms from the Jurassic and Cretaceous of Switzerland, Hungary, and other European countries. Apparently, they are the first microfossils to be formally described from California.

In 1895, Professor A. C. Lawson of the University of California noted that both Foraminifera and Radiolaria occur in the limestones and cherts of the Franciscan series in the San Francisco Peninsula and at other localities in the Coast Ranges. Four genera of Foraminifera (*Orbulina*, *Globigerina*, *Textularia*, and *Rotalia*) were identified for him by Charles Schuchert of the U.S. National Museum, who then submitted the fauna to Charles D. Walcott for determination of their geologic age. This latter scientist, an authority on trilobites and Cambrian stratigraphy, stated that the assemblage indicated an age not earlier than Cretaceous.

In the next decade (1895-1905), the only references to microfossils in California that are now considered to be of Cretaceous age are those by Lawson (1903), who divided the Franciscan of the Middle Coast Ranges "into seven stratigraphic subdivisions by the recognition of a persistent horizon of foraminiferal limestone [Calera] and two important horizons [Sausalito and San Miguel] of radiolarian chert", and by F. M. Anderson (1905) who observed in "Eocene" shales of the Mt. Diablo range north of Coalinga seven genera of Foraminifera, including *Sagrina*—which today we refer to as *Siphogenerinoides whitei*, a guide to the late Upper Cretaceous. Inasmuch as this latter publication is thought to be the first California report to contain an illustration of a Cretaceous foraminifer, it, too, is of historical interest.

From 1905 to the end of the period, the few records dealing with Cretaceous microfossils are concerned mainly with their stratigraphic occurrences or with their ecology. It was during this time that the type Moreno formation on the west side of San Joaquin Valley with its wealth of diatoms, radiolarians, and fish scales was undergoing careful examination by Robert Anderson and R. W. Pack (1915) and by T. D. A. Cockerell (1919). As we shall see, many of these fossils were to be described in later years.

Period II (1927-1941)

This 15-year time span—the "Hanna-Moreno" Period—is named in honor of G. Dallas Hanna of the California Academy of Sciences for his detailed studies of the Moreno formation and its associated microfossils. During these years this scientist issued a number of reports on the diatom floras and silicoflagellates of the late Upper Cretaceous Fresno County unit. The unusually well-preserved diatom assemblages of the Moreno, it has been said, were the first Cretaceous microfloras to be described from the Americas. Following the investigations by Hanna, research on the chrysamonad flagellates and foraminifers of the formation was undertaken by many other micropaleontologists, among whom were Joseph A. Cushman and Arthur S. Campbell (1934, 1935), Lois T. Martin (1936), and Leopoldo Rampi (1940).

Cushman and Campbell examined Foraminifera from "Chico" beds near Selby in Contra Costa County and from the subsurface "Moreno" shale near Tracy, supplying new information as to their ages and suggesting correlations with the uppermost Cretaceous of the Gulf Coastal Plain; Martin compiled a comprehensive checklist of American Cretaceous Foraminifera, of which the 53 species from the Moreno formation was one of the many Upper Cretaceous assemblages analyzed; and Rampi reported what is believed to be the first Cretaceous archaeomonad assemblage from western America. It was also during this period that Cushman and Clifford C. Church (1929) discovered a large Upper Cretaceous "Chico" foraminiferal fauna in a well near Coalinga. This assemblage—one then entirely new to California paleontology—was the first of such in the State to receive both detailed description and illustration.

Period III (1942-1960)

It is largely due to the contributions of Professor H. E. Thalmann, Stanford University, and the late Dr. Paul Goudkoff of Los Angeles, to the zonal stratigraphy of the Upper Cretaceous of California that Period III is named. In particular, it is a result of thin-section studies by Thalmann (1942-43) of limestones from the Perma-

nente quarry in Santa Clara County, Marin County, and near Laytonville in Mendocino County, that these rocks, with their associated specimens of the foraminiferal genus *Globotruncana*, were assigned for the first time to a European Cretaceous stage. On the basis of the then known range of various species of this planktonic organism, an age not older than Turonian or younger than Santonian (lower Senonian) was ascribed to the above-mentioned strata and their correlative—the Calera limestone—at its type locality at Rockaway Beach in San Mateo County. Thus, it was in this manner that the Calera portion of the type Franciscan group, as designated by Lawson, was removed from the Jurassic system where so many had placed it. (Later investigators, including Thalmann himself, were to assign the Calera to even an earlier stage in the Upper Cretaceous—the Cenomanian.)

Then in 1945, after a preliminary study in 1942, Goudkoff issued what has come to be called the "Bible" of the Upper Cretaceous of the Great Valley of California—a monumental work on the stratigraphic position of numerous Foraminifera from over 100 surface sections and well cores ranging from Redding in the northern part of the State to the Lost Hills area in the south. He divided the Upper Cretaceous into 6 stages and 10 zones, including ecological variations of the latter bundles of strata, and correlated them with the well-known Texas Cretaceous "groups". Just a year prior to his Great Valley studies, Goudkoff (1944), in cooperation with Joseph A. Cushman, recorded and illustrated 28 species and varieties of Upper Cretaceous Foraminifera from various counties in California, listing the stratigraphic position of the fossiliferous samples, in most cases, in reference to the top of the Moreno formation. Some of these species later were utilized as zonal indices to the Upper Cretaceous of the Great Valley.

During this period also Arthur S. Campbell and the late Bruce L. Clark (1942, 1944) were investigating a rich radiolarian fauna from the Tesla area in Middle California. The 86 species and varieties recorded by them as coming from a cubic inch of limestone near the top of a shale sequence that was stated to be "probably older than Moreno" represent one of the world's richest Cretaceous assemblages. About this time Lore R. David (1942, 1946) was undertaking a microscopic examination of fish scales from the Upper Cretaceous along the western border of San Joaquin Valley; J. A. Long, D. P. Fuge, and James Smith (1946) were studying the diatoms of the Marca shale member of the Moreno formation in the Panoche Hills; and Cushman and Ruth Todd (1948) had completed the first of several examinations of Foraminifera from the New Almaden district in Santa Clara County.

In rapid succession during the early years of the last decade came a report by Orville L. Bandy (1951) on a well-preserved foraminiferal fauna of Campanian (Taylor) age from the Carlsbad area in San Diego County; a publication by Max B. Payne (1951) on the type Moreno formation in which the diagnostic foraminifers of this unit, as well as some from the underlying Panoche, were for the first time stratigraphicall allocated; a work by Clifford C. Church (1952) on Fora minifera from the type Calera limestone, in which middle to Upper Cenomanian age was suggested for th member of the Franciscan; a paper by Manley L. Na land and W. T. Rothwell, Jr. (1954) dealing with foraminiferal assemblage of Campanian, or possibl Maastrichtian age, from the Ventura Basin, the Sant Ana Mountains, and San Diego County areas; and a article by the late Klaus Küpper (1955) who recorde from the New Almaden area an entirely different name assemblage of Foraminifera than that described by Cush man and Todd in 1948, inferring for it an early or medi Cenomanian age, not Lower Cretaceous as the latter au thors had reasoned. All these publications were instru mental in laying a firm foundation for a more secur tie-in between the California Cretaceous and the Eur pean standard section.

A discussion of the geologic age of the type Cale limestone again arose in 1956, when Küpper discovere pelagic foraminifers in the "Antelope Shale" of Gler and Colusa Counties. He noted that the northern Cal fornia assemblages contained certain species in commo with the Calera which indicated to him an age equiv lency (Upper Cenomanian) for these widely separate units.

Also in 1956, after a lapse of many years, the Radi laria of the Franciscan group again came to the attentio of micropaleontologists by the discovery of an asser blage in the Sausalito chert portion of the Francisc east of Belmont by William R. Riedel and Juli Schlocker. This fauna showed similarities, as they p it, "with species from the Jurassic and Cretaceous other parts of the world", but they were unable to dete mine to which system it should be referred.

In the two years that followed (1957-58) a numb of publications were issued on rich foraminiferal faun from the Upper, Middle, and Lower Cretaceous of Ca fornia: Francis P. Shepard, R. R. Lankford, and E. De Milow (1957) called attention to an assemblage of 1 species from the Upper Cretaceous of the La Jolla a San Diego basins—one containing many forms not pr viously recorded from California; Peter U. Rodda (195 recorded ones of late Albian to Turonian ages in the s called Middle Cretaceous of northwestern Sacramen Valley; and Andrew W. Marianos and Richard Zingula (1958) (see also Zingula, 1958) discovered si nificant planktonic and benthonic faunas of "at least Ba remian to Turonian" age in the Dry Creek area of T hama County.

During the preparation of this bibliography, Ernest Trujillo (1958, 1960) reported on Upper Cretaceo Foraminifera from near Redding, describing and illu trating numerous forms of Middle Turonian, Coniacia and Santonian ages; Alvin A. Almgren (1959) conclud that the "world-wide" foraminifer *Reussella szajnoch* var. *californica* in the Sacramento Valley is restricted Upper Campanian sediments "no older than the upp part of Goudkoff's F-1 zone and no younger than ba

: zone", not to Goudkoff's G-1 zone as once thought; oseph J. Graham and C. C. Church (1959) noted a ırge Campanian foraminiferal fauna from the Stanford :ampus in Santa Clara County; and Alfred R. Loeblich, r. and Helen Tappan (1959) suggested a mid- to upper :enomanian age for the limestone of the New Almaden istrict instead of an upper Albian or an early or medial :enomanian age ascribed to it by previous authors.

Early in 1960, Max B. Payne, in cooperation with ewis Martin and Professor Tatsuro Matsumoto, pub- shed what many micropaleontologists believe is a highly ignificant contribution to California stratigraphy: a hart showing the "zones" and ranges of 11 important uide foraminifers for the Upper Cretaceous (Coniacian o Maastrichtian) sequence in southwestern Fresno County; and later in the same year O. T. Marsh recorded important foraminiferal assemblages from the Cretaceous of the Orchard Peak area in the southern end of the Diablo Range; W. T. Popenoe, R. W. Imlay, and M. A. Murphy added additional information on the zones of Goudkoff; J. J. Graham and D. K. Clark described and illustrated the occurrence of a new species from the Upper Cretaceous Uhalde formation (Panoche Group) and the Dosados member of the Moreno formation of Fresno County; M. A. Furrer suggested that California Cretaceous "*Siphogenerinoides*" be allocated to other categories, and D. H. Dailey discussed the foraminiferal fauna of the Campanian Jalama formation of the western Santa Ynez Mountain of Santa Barbara County.

European Standard of the Cretaceous System.

Series	* Stages and Substages	
UPPER CRETACEOUS	** DANIAN	
	MAASTRICHTIAN	
	SENONIAN	CAMPANIAN
		SANTONIAN
		CONIACIAN
	TURONIAN	
	CENOMANIAN	
LOWER CRETACEOUS	ALBIAN	
	APTIAN	
	NEOCOMIAN	BARREMIAN
		HAUTERIVIAN
		VALANGINIAN
		BERRIASIAN

* For derivation of stage names and type localities see: Muller, S.W., and Schenck, H.G., Standard of Cretaceous System: Bull. Amer. Assoc. Petroleum Geologists, v. 27, No. 3, p. 266, 1943.

** Many biostratigraphers consider the Danian to be the lowermost stage of the Paleocene Series (Tertiary System), a few are of the opinion that it is a "well-characterized" stage between the uppermost Cretaceous (Maastrichtian) and the Paleocene, and some believe that the Danian and Maastrichtian are correlatives.

LIST OF ABBREVIATIONS

C.A.S.	California Academy of Sciences
L.S.J.U.	Leland Stanford Junior University
M.D.B. & M.	Mt. Diablo Base and Meridian
S.B.B. & M.	San Bernardino Base and Meridian
S.U.	Stanford University
U.C.	University of California
U.C.M.P.	University of California Museum of Paleontology
U.S.C.	University of Southern California
U.S.G.S.	United States Geological Survey

BIBLIOGRAPHY

1891

1. TURNER, H. W.

The geology of Mount Diablo, California: Geol. Soc. America, Bull., v. 2, p. 383-402, figs. 1-3, pl. 15 (geologic map).

Occurrence of Foraminifera in the Upper Cretaceous Chico beds is mentioned. (This is thought to be the earliest reference to Cretaceous microfossils in California; however, no generic or specific determinations are made; no detailed stratigraphic allocation of the Foraminifera is recorded, and the locality of the fossils is not given.)

1894

2. HINDE, G. J.

Note on the radiolarian chert from Angel Island, and from Buri-buri Ridge, San Mateo County, California: As an appendix *in* Ransome, F. L., The geology of Angel Island: Univ. Calif., Dept. Geol. Bull., v. 1, no. 7, p. 235-240, pl. 14 (19 figs.).

Nineteen Radiolaria within 10 genera (*Cenosphaera* and *Caroposphaera* of the suborder Sphaeroidea, *Cenellipsis*, *Ellipsidium* and *Lithapium* of the suborder Prunoidea, *Tripocyclia* and *Hagiastrum* of the suborder Discoidea, and *Dictyomitra*, the most distinctive genus in number and variety of forms, *Lithocampe*, and *Sethocapsa* of the suborder Cyrtoidea) are described and figured.

They are poorly preserved, and thus difficult to identify specifically. Satisfactory comparison with fossils from other localities is not possible "but the character of the rock and mode of preservation appear to be very similar to what is met within the red radiolarian jaspers and cherts of Jurassic and Cretaceous age . . . in the Tyrol, Switzerland, Hungary, and other places."

1895

3. LAWSON, A. C.

Sketch of the geology of the San Francisco peninsula: Fifteenth Ann. Rept., 1893-94, U. S. Geol. Surv., p. 399-476, figs. 6-8, pls. 5-12 (including geologic map).

Undeformed tests of Foraminifera belonging to four genera (see Lawson, 1895b) and an abundance of Radiolaria (see Hinde, 1894) are recorded from thin sections of limestones and cherts of the Franciscan series of Cretaceous or Jurassic age.

4. LAWSON, A. C.

A contribution to the geology of the Coast Ranges: American Geologist, v. 15, p. 342-356.

The foraminiferal limestones and radiolarian cherts of the Franciscan series are discussed—with the foraminifers embracing (according to Schuchert) the genera *Orbulina*, *Globigerina*, *Textularia*, and *Rotalia*. These forms indicate, so Professor Walcott states, an association not earlier than the Cretaceous. The radiolarian genera (Hinde, 1894) are similar to those in the Cretaceous and Jurassic rocks of Europe, appearing as sharply discrete casts in a dense siliceous matrix. "The suggestion that they are deep sea deposits is negatived by their interbedding with sandstones."

"The Foraminifera are represented by clear hyaline spots ranging in size up to .5 mm, which, in favorable cases, may be observed with the lens to have the form of shells." They are not deformed by dynamic action, are quite discrete from the matrix, and are more or less sporadically entombed.

"The general tendency of this paleontological evidence is to place the Franciscan series in the Cretaceous. This would harmonize with the sug-

gestion thrown out on a former page that the granite upon which the series reposes is of post-Jurassic age. It is the opinion of both Whitney and Becker that the rocks of this series are of Cretaceous age.

"The writer reserves his opinion on the question till further evidence has been gathered and is content for the present to point out that the evidence, such as it is, is confirmatory of the opinion of Whitney and Becker. It remains to be said, however, that the series as a whole is very probably older than the Knoxville *Aucella* horizon of California."

1903

5. LAWSON, A. C.

Geological section of the middle Coast Ranges of California: Geol. Soc. America, Proc. 3rd Ann. Meeting, Cordilleran Sec., v. 13, p. 544-545.

The Franciscan is divided "into seven stratigraphic subdivisions by the recognition of a persistent horizon of foraminiferal limestone [Calera] and two important horizons [Sausalito and San Miguel] of radiolarian chert." (The geologic age of the Franciscan is not given).

1905

6. ANDERSON, F. M.

A stratigraphic study in the Mount Diablo Range of California: Proc. Calif. Acad. Sci., 3rd ser., v. 2, no. 2, p. 155-248, pls. 13-35.

Seven foraminiferal genera—*Nodosaria, Lagena* (?), *Sagrina, Vaginulina, Cyclammina, Pulvulina* [*Pulvinulina*], and *Polymorphina* (?)—are figured from "Eocene" [Cretaceous] shales in the range north of Coalinga.

(The *Sagrina* is thought to be the first foraminifer to be illustrated from the Cretaceous of California. It is now assigned to *Siphogenerinoides whitei* Church, a species restricted to the Upper Cretaceous—see Hanna, 1925, p. 992; and Long; Fuge, and Smith, 1946, p. 91).

1910

7. ARNOLD, RALPH AND ANDERSON, ROBERT

Geology and oil resources of the Coalinga District, California: U.S. Geol. Surv., Bull. 398, 354 p., 52 pls. (including geologic and structural map), 9 figs.

Organic shales of the uppermost member of the Chico formation with their large number of Foraminifera, diatoms, and other organisms are assumed to be the source of petroleum. (Thomas F. Stipp in "The relation of Foraminifera to the origin of California petroleum": Calif. Acad. Sci., Proc., 4th ser., 1926, v. 15, no. 9, p. 263-268 and Amer. Assoc. Petroleum Geologists, Bull., v. 10, no. 7, 1926, p. 697-702, has a quote of the above reference.)

1914

8. LAWSON, A. C.

Description of the San Francisco district: Tamalpais, San Francisco, Concord, San Mateo, and Haywards quadrangles: U. S. Geol. Surv., Geol. Atlas, San Francisco folio No. 193, 24 p., 4 figs., 10 pls., maps and columnar section.

In "the Cahil formation (of the Franciscan group) there is a conspicuous foraminiferal limestone (Calera), an oceanic deposit, laid down far from shore, which separates the sandstones below and above it into distinct divisions."

The radiolarian cherts of the Franciscan group are referred to and a statement is made that "neither the Foraminifera of the Calera limestone nor the Radiolaria of the Sausalito and Ingleside cherts appear to be sufficiently distinctive to determine the age of the rocks in which they are found."

1915

9. ANDERSON, ROBERT, AND PACK, R. W.

Geology and oil resources of the west border of the San Joaquin Valley north of Coalinga, California: U. S. Geol. Surv., Bull. 603, 220 p., 14 pls., 5 figs.

Reference is made to the foraminiferal and diatomaceous shale (no species are recorded) in the upper part of the Upper Cretaceous Moreno formation (Chico group) at its type locality in Moreno Gulch on the east flanks of the Panoche Hills, Fresno County, and elsewhere in California.

1918

10. DAVIS, E. F.

The radiolarian cherts of the Franciscan group: Calif. Univ. Dept. Geol., Publ., v. 11, no. 3, p. 235-432, pls. 25-36, 16 text-figs.

A detailed discussion is given of the Franciscan cherts and their radiolarian content (however, no species of Radiolaria are mentioned). The term "radiolarian chert" is stated to be misleading inasmuch as only a fraction of the siliceous rock contains these protozoans.

1919

11. COCKERELL, T. D. A.

Some American Cretaceous fish scales: U.S. Geol. Surv., Prof. Paper 120-I, p. 165-202, pls. 31-37.

Four new species (within 2 new genera) are recorded and illustrated from the Moreno formation of the Chico group in the middle Coast Ranges. These are: *Pomolobus ? chicoensis, Echidnocephalus ? pacificus, Chicolepsis punctatus,* and *Erythrinolepsis chicoensis,* the latter two within the new genera.

Localities from which these scales, the first Cretaceous fish remains to be recorded from California, were collected are the south side of Ortigalita Creek, "1 mile above the mouth of its canyon and

1¼ miles northeast of Erreca's, in the base of gully draining north along west line of the SW¼ sec. 20, T. 11 S., R. 10 E." (U.S.G.S. Loc. 7030), and the "foothills between Little Panoche and Ortigalito creeks" (U.S.G.S. Loc. 7027).

1921

12. VANDER LECK, LAWRENCE

Petroleum resources of California: Calif. State Mining Bureau, Bull. 89, 186 p., frontis., 12 text-figs., 6 pls., 6 photographs.

In discussing the organic theory of the origin of oil in California the author writes: "the diatom and foraminifera lived at the surface of warm inland seas, such as were present in what is now the great valley and coast ranges of California, during the various geological ages from the Cretaceous to the present."

1925

13. HANNA, G. D.

The age and correlation of the Kreyenhagen shale in California: Amer. Assoc. Petroleum Geologists, Bull., v.9, no. 6, p. 990-999.

Sagrina sp.[= *Siphogenerinoides whitei* Church see Long, Fuge, and Smith, 1946] a foraminifer listed by Anderson (1905) from the "Eocene" of the Mount Diablo Range (north of Coalinga) is is assigned to the Cretaceous.

1926

14. TAFF, J. A., AND HANNA, G. D.

Notes on the age and correlation of the Moreno shale: Amer. Assoc. Petroleum Geologists, Bull., v. 10, no. 8, p. 812-814.

Impressions of large numbers of Foraminifera, chiefly of the genus *Siphogenerina* [*Siphogenerinoides whitei* Church, 1943], various genera of diatoms, and a few radiolarians characterize the upper portion of this Upper Cretaceous unit in Moreno Gulch, Fresno County, California.

15. HANNA, G. D.

The lowest Tertiary diatoms in California: Jour. Paleontology, v. 1, no. 2, p. 103-127, pls. 17-21.

The Moreno shale of Upper Cretaceous age is the oldest deposit in California known to contain fossil diatoms.

1927

16. HANNA, G. D.

Cretaceous diatoms from California: Occas. Papers Calif. Acad. Sci., no. 13, 48 p., 5 pls.

Thirty-seven species—comprising an assemblage stated to be the first diatom flora recorded from the Cretaceous of the Americas—are described and illustrated from the type locality of the Upper Cretaceous Moreno formation [Marca shale member in sec. 11, T. 14 S., R. 11 E., M.D.B. & M.], Moreno Gulch, Fresno County.

The flora contains six new genera *(Benetorus, Glorioptychus, Horodiscus, Meretrosulus, Micrampulla,* and *Sphynctolethus)* and 27 new species *(Actinoptychus packi, A. taffi, Aulacodiscus cretaceous, A. pugnalus, Auliscus aenigmus, Benetorus fantasmus, Cladogramma jordani, Coscinodiscus immaculatus, C. morenoensis, C. steinyi, Glorioptychus callidus, Horodiscus macroscriptus, Kentrodiscus aculeatus, K. andersoni, Meretrotrosulus gracilis, Micrampulla parvula, Odontropis galeonis, Pseudostectodiscus picus, Pterotheca crucifera, P. evermanni, Sphynctolethus monstrosus, Stephanopyxis discrepans, Triceratium bicornigerum, T. hertleini, Trinacria deciusi, T. tristictia,* and *Xanthiopyxis granti).* The others are: *Heniaulus polymorphus, Liradiscus ovalis, Melosira fausta, Pseudopyxilla russica, Stephanopyxis appendiculata, S. grunowi, Trinacria aries, T. excavata, T. insipiens,* and *T. micronata.* (See Tynan, 1960.)

1928

17. CUSHMAN, J. A.

A Cretaceous *Cyclammina* from California: Contr. Cushman Lab. Foram. Res., v. 4, pt. 3, p. 70-72, pl. 9 (figs. 5a, b).

Cyclammina schencki n. sp. is described and figured from a black shale, perhaps of Cretaceous age, below the Tejon Eocene sandstone at Topatopa Bluff, Ventura County, Mt. Pinos Quadrangle (L.S.J.U. Loc. 668). (Later work has shown that this foraminiferal species is from the Eocene Juncal shale.)

18. HANNA, G. D.

Silicoflagellata from the Cretaceous of California: Jour. Paleontology, v. 1, no. 4, p. 259-263, pl. 41.

Three new genera *(Corbisema, Lyramula,* and *Vallacerta)* and 5 new species *(Corbisema geometrica, Dictyocha quadralta, Lyramula furcula, L. simplex,* and *Vallacerta hortoni)* are described and figured from 66 feet below the top of the Upper Cretaceous Moreno shale (140-200 feet below Cretaceous-Eocene contact) in the SW.¼ NE.¼ sec. 6, T. 15 S., R. 12 E., M. D. M., Panoche Hills, Fresno County (C.A.S. Loc. 1144). This locality is a few miles south of the type locality of the Moreno formation.

19. KERR, P. F., AND SCHENCK, H. G.

Significance of the Matilija Overturn: Geol. Soc. America, Bull., v. 39, p. 1087-1102, 4 figs . . . (Also see Abstracts in Geol. Soc. America, Bull., v. 39, p. 187, 1928; Pan-Amer. Geologist, v. 49, no. 1, p. 77, 1928).

Arenaceous Foraminifera are recorded (species not listed) from the Cretaceous Chico formation at Matilija, Ventura County, California. (The beds in which the fossils occur are now assigned to the Eocene.)

1929

20. CHURCH, C. C.

Occurrence of *Kyphopyxa* in California: Jour. Paleontology, v. 3, no. 4, p. 411.

Kyphopyxa, a foraminiferal genus, is recorded from Upper Cretaceous clay shales in sec. 36, T. 23S., R. 17E., at south end of Reef Ridge, Kings

Co., and 4.8 miles up Salsipuedes Creek from the junction with El Jaro Creek (about 10 miles south of Lompoc in Santa Barbara County).

21. CUSHMAN, J. A., AND CHURCH, C. C.

Some Upper Cretaceous Foraminifera from near Coalinga, California: Proc. Calif. Acad. Sci., 4th ser., v. 18, no. 16, p. 497-530, pls. 36-41.

Forty-three species (including 5 which are new, *Silicosigmoilina californica*, *Ventilabrella ornatissima*, *Chrysalogonium cretaceum*, *Nodosarella coalingensis*, and *Gyroidina quadrata*) and one new genus—*Silicosigmoilina*—are described and illustrated from the Chico shale at the 1135 foot level of the California Northern Petroleum Company Well #19 in sec. 2, T. 21 S., R. 14 E., (Alcalde Hills, west of Coalinga, Fresno County). The remainder of the fauna consists of *Spiroplectammina anceps*, *Gaudryina oxycona*, *G. ruthenica*, *Quinqueloculina* sp., *Lenticulina rotulata*, *L. williamsoni*, *Lenticulina* sp.?, *Robulus trachyomphalus*, *R. lepidus*, *Saracenaria triangularis*, *Marginulina humilis*, *M. modesta*, *M. elongata*, *M. bullata*, *M. jonesi*, *Vaginulina simondsi*, *Frondicularia decheni*, *Frondicularia* sp.?, *Dentalina* sp.?, *D. catenula* (?), *D. polyphragma*, *D. communtata*, *Nodosaria nuda*, *N. ewaldi* (?), *Glandulina cylindracea*, *G. manifesta*, *Lagena* (?) sp. (?), *Lagena* sp. (?), *Bulimina obtusa*, *Ellipsobulimina* (?) sp. (?), *Discorbis cretacea* (Franke) (?), *Eponides umbonella*, *Gyroidina depressa*, *Epistomina caracolla*, *Allomorphina cretacea*, *Pullenia quinqueloba*, *Globotruncana arca*, and *Cibicides convexa*. (See Harris and McNulty, 1956).

". . . This fauna probably represents the uppermost Cretaceous corresponding rather closely with the Navarro of Texas and the Velasco of Mexico . . .". Inference is made that the Coalinga locality represents "an area perhaps somewhat cut off from the main ocean of that time, and into which pelagic forms were not carried to any great extent."

22. PARKER, R. W. (editor)

Siphogenerina in the Cretaceous of California: Micropaleontology Bull., v. 1, no. 10, p. 31 (Discussion, pt. B).

"Cushman, in 1926, [Foraminifera of the Atlantic Ocean. Family 5, Lagenidae, U. S. Nat. Mus. Bull. 104, pt. 4, p. 173] stated that the genus *Siphogenerina* seems to be confined to the Tertiary because its presence below the Eocene was not well established. In the same year he described *Siphogenerina plummeri* from the Navarro Clays, upper Cretaceous, near Kemp, Texas [*Siphogenerina plummeri*, a Species from the Upper Cretaceous of Texas: Contr. Cushman Lab. Foram. Research, v. 2, pt. 1, p. 15, pl. 1, figs. 7a-c]. Still later, Cushman stated [1928—Foraminifera, Their Classification and Economic Use: Contr. Cushman Lab. Foram. Research, Spec. Publ. no. 1, p. 257] that the range of the genus is "Cretaceous (?) Eocene to Recent". In view of the fact that numerous representatives of the genus have been obtained from the Moreno shale, upper Cretaceous, near Mercy Springs, 39 miles northwest of Coalinga, California, it seems reasonable to conclude that the geologic range of the genus is at least from the Cretaceous to Recent."

1931

23. CHURCH, C. C.

Cretaceous—Eocene contact north of Coalinga, California: *in* Geologic notes: Amer. Assoc. Petroleum Geologists, Bull., v. 15, no. 6, p. 697-699.

Arenaceous Foraminifera, "most of which have siliceous cementing material", occur in profusion; but calcareous forms are rare in the "massive, hard, red-brown" Upper Cretaceous Moreno shale.

1932

24. NOMLAND, J. O., AND SCHENCK, H. G.

Cretaceous beds at Slate's Hot Springs, California: Univ. Calif., Publ. Geol. Sci., v. 21, no. 4, p. 37-49, 4 figs.

Thin sections of late Upper Cretaceous shales (Asuncion formation, according to Taliaferro, 1944, p. 499, 507), formerly mapped as belonging to the Franciscan series, "disclose presence of Foraminifera" among which "are fragments of what appear to be *Globigerina*, a genus that seems to be present in some of the Franciscan limestones of the San Francisco Bay region." (Matsumoto, 1960, p. 74, suggests an Upper Campanian age for these Monterey County shales).

1933

25. REED, R. D.

Geology of California: Amer. Assoc. Petroleum Geologists, Tulsa, Oklahoma, 355 p., 60 figs. (including maps).

Refers to the small fossils of the Upper Cretaceous Moreno shale, which "consist of Foraminifera, diatoms, radiolarians, and silicoflagellates". It is also stated—see footnote on p. 110—that the commonest foraminifer, according to H. G. Schenck, belongs to the genus *Siphogenerinoides*, not *Siphogenerina*.

1934

26. CUSHMAN, J. A., AND CAMPBELL, A. S.

A new *Spiroplectoides* from the Cretaceous of California: Contr. Cushman Lab. Foram. Res., v. 10, pt. 3, p. 70-71, pl. 9 (figs. 15-17).

Spiroplectoides californica n. sp., is described and illustrated from the Upper Cretaceous (Upper Chico) near Selby, Contra Costa County. The species also occurs in Chico beds near Bakersfield (Devil's Den area) and in the Moreno shale of Panoche Canyon, near Coalinga. Nearly always associated with *S. californica* is *Silicosigmoilina californica*, a common species of the Chico in California. (See Frizzell, 1943, p. 339, for generic change of *S. californica* to *Spiroplectammina*.)

27. HANNA, G. D.

Additional notes on diatoms from the Cretaceous of California: Jour. Paleontology, v. 8, no. 3, p. 352-355, 1 pl.

One new genus (*Chasea*), 2 new species (*Chasea bicornis* and *Rattrayella churchi*), and 6 other diatoms (*Aulacodiscus archangelskianus, Haynaldia strigillata, Benetorus fantasmus, Coscinodiscus lineatus, Micrampulla parvula, and Xanthiopyxis granti*) are described and illustrated from the Moreno formation [Marca shale member] in sec. 6, T. 15 S., R. 12 E., M.D.M., Panoche Hills, Fresno County (C.A.S. Loc. 1144), a few miles south of the locality from which Hanna (1927) recorded 37 species.

28. HANNA, G. D.

Additional notes on diatoms from Cretaceous of California: Geol. Soc. America, Proc. 1933, p. 377 (Abs.).

Diatomite from localities other than the ones from which the original records were made (see Hanna, 1927, 1934; Hanna and Hertlein, 1943; Long, Fuge, and Smith, 1946) have yielded additional species, which tend to confirm the correlation of the Upper Cretaceous (Moreno) formation of California with formations of Russia.

1935

29. CUSHMAN, J. A., AND CAMPBELL, A. S.

Cretaceous Foraminifera from the Moreno shale of California: Contr. Cushman Lab. Foram. Res., v. 11, pt. 3, p. 65-73, pls. 10-11.

An assemblage of 20 species and varieties from a well on the leasehold of the Amerada Exploration Company near Tracy, San Joaquin County, is described and figured. Of these, five species and one variety are new (*Marginulina striatocarinata, Flabellina pilulifera, Frondicularia seminiformis, Nodosaria spinifera, Bulimina spinata,* and *Gaudryina navarroana* Cushman var. *crassaformis*). Other forms are: *Bolivina* cf. *decurrens, B. incrassata, Bulimina obtusa, Dentalina* cf. *megalopolitana, Frondicularia archiaciana, Frondicularia* sp. (?), *Nodosaria* cf. *alternata, N. monile, N. velascoensis, Nodosaria* sp. (?), *Nodosaria* sp. (?), *Marginulina* cf. *M. bronni, M. grata,* and *Vaginulina* cf. *simondsi.*

The faunule suggests relationship with the uppermost Cretaceous of the Gulf Coastal Plain, especially with the Velasco shale of Mexico and the Cretaceous of Trinidad. Typical forms of *Nodosaria velascoensis* Cushman, known from Mexico and Trinidad, were found in the well samples, and the new species *Frondicularia seminiformis* is noted as occurring in the Velasco shale of Mexico.

Some of the Moreno species "seem to range somewhat lower" in the Cretaceous of the Gulf Coast and appear to be identical to Upper Cretaceous forms from Europe. (Long, Fuge and Smith, 1946, p. 91, state that some workers are of the opinion the well samples are from the Panoche, not Moreno formation).

30. LALICKER, C. G.

New Cretacous Textulariidae: Contr. Cushman Lab. Foram. Res., v. 11, pt. 1, 16 p., 2 pls.

Two new species of *Spiroplectammina* (*S. chicoana* and *S. sigmoidina*) from California Northern Petroleum Company Well #19, sec. 2, T. 21 S., R. 14 E., near Coalinga, Fresno County, California—both from a depth of 1000-1135 feet—are described and illustrated. *S. anceps* (Reuss) of Cushman and Church (1929, p. 500, pl. 36, figs. 1-2) from the Upper Cretaceous near Coalinga is listed as a synonym of *S. chicoana.* (See Cushman and Hedberg, 1941.)

1936

31. CUSHMAN, J. A.

Cretaceous Foraminifera of the Family Chilostomellidae: Contr. Cushman Lab. Foram. Res., v. 12, pt. 4, p. 71-78, pl. 13.

States that the only American record of *Allomorphina cretacea* Reuss is from the Upper Cretaceous near Coalinga, California. (See Cushman and Church, 1929.)

32. CUSHMAN, J. A. AND CAMPBELL, A. S.

A new *Siphogenerinoides* from California: Contr. Cushman Lab. Foram. Res., v. 12, pt. 4, p. 91-92, pl. 13 (figs. 9-12).

Siphogenerinoides clarki n. sp. is described and figured from a black shale of the uppermost Cretaceous along Marsh Creek, ½ mile southwest (the authors erroneously reported northeast) of the Marsh house, Mt. Diablo quadrangle, Contra Costa County. (See Cushman and Parker, 1937).

33. MARTIN, L. T.

Check list of American Cretaceous Foraminifera: Edwards Brothers, Inc., Ann Arbor, Michigan, 21 p., 2 sheets . . . (Also see Abstract in Geol. Soc. America Proc. 1936 (1937), p. 382).

"The species described in 100 papers on Cretaceous Foraminifera from North and South America and the West Indies have been compiled into a check list to show geologic range and geologic-geographic distribution [includes 53 species from the Upper Cretaceous Moreno formation of California]. The list includes 852 species, the last nomenclature revisions being used. An accompanying species index gives the older names, and also refers to the respective publications from which the data were derived. These publications are listed in the appended bibliography. The chronological use of the check list is especially satisfactory if each faunule analyzed comprises 30 or more species" (Abs.).

34. SCHENCK, H. G.

Nuculid bivalves of the genus *Acila:* Geol. Soc. America, Special Papers no. 4, xiv + 148 p., 15 figs., 18 pls., 17 tables.

Siphogenerinoides, a foraminiferal genus, is recorded from a white concretionary limestone bed approximately 300'-400' stratigraphically below the top of the Moreno shale near the center of sec. 17, T. 19 S., R. 15 E., M.D.M., northeast of Oil City, California. It is associated with *Baculites* and other fossils.

1937

35. CUSHMAN, J. A., AND PARKER, F. L.

Notes on some European Eocene species of *Bulimina:* Contr. Cushman Lab. Foram. Res., v. 13, pt. 2, p. 46-54, pl. 6.

Corrected locality of *Siphogenerinoides clarki* Cushman and Campbell (1936, p. 91) from the Upper Cretaceous of California is given (by C. C. Church) as follows: "Marsh Creek, Contra Costa County, California, at the bend just below mouth of Briones Creek, ½ mile southwest of John Marsh house, S/2, SW/4, NW/4, Section 35, Township 1 North, Range 2 East, M. D. B. & M., Byron Quadrangle."

36. MARTIN, L. T.

Upper Cretaceous Foraminifera from the Chico formation of Santa Clara County, California: Geol. Soc. America, Proc. 1936, p. 394-395 (Abs.).

"The fossils studied are from the Chico formation exposed along the bed of San Francisquito Creek northeast of Searsville Lake. The Cretaceous strata near the lake aggregate about 2500 feet in thickness and are in contact with serpentine; to the northeast, they are overlain unconformably by the Temblor formation (mapped as "Purisima" of the United States Geological Survey Santa Cruz folio, 1909) carrying lower Luisian foraminifers. The Cretaceous assemblage includes such species as *Gyroidina depressa* (Alth), *Nodosaria velascoensis* Cushman, *N. spinifera* Cushman and Campbell, *Glomospira corona* Cushman and Jarvis, *Spirillina vivipara* Ehrenberg, *Haplophragmoides coronata* (Brady), *H. excavata* Cushman and Waters, and many new species.

"The assemblage is Upper Cretaceous; some of the species are common in the Velasco shale of Mexico, Lizard Springs of Trinidad, and the Moreno shale of California. Hence, the beds along San Francisquito Creek are younger than the Turonian Stage and older than the Danian. If Anderson and Hanna * are correct in placing the age of the type Chico as Turonian and older, then the Chico formation of the San Francisco Peninsula is, at least in part, younger than the Chico formation at its type area". (See Graham and Classen, 1955.)

* F. M. Anderson and G. D. Hanna: Cretaceous geology of Lower California, Calif. Acad. Sci., Proc., 4th ser., v. 23, no. 1, (1935), p. 18.

37. THALMANN, H. E.

Mitteilungen über Foraminiferen III: 14. Bemerkungen zu den Gattungen *Vaginulinopsis* Silvestri, 1904, *Marginulinopsis, Silvestri,* 1904, und *Hemicristellaria* Stache, 1864: Eclogae geol. Helvet., v. 30, no. 2, p. 346-356, pls. 21-23.

Marginulina jonesi Reuss of Cushman and Church (1929, p. 507, pl. 38, figs. 7-9) from the Upper Cretaceous near Coalinga, California, is renamed *Marginulinopsis decursecostata* Thalmann, n. sp.

1938

38. CUSHMAN, J. A.

Cretaceous species of *Gümbelina* and related genera: Contr. Cushman Lab. Foram. Res., v. 14, pt. 1, p. 2-28, pls. 1-4.

The comment is made that "there are no other published records" of *Ventilabrella ornatissima,* described by Cushman and Church (1929, p. 512, pl. 39, figs. 12-14) from the Upper Cretaceous near Coalinga, California. (See Montanaro Gallitelli, 1957, pl. 32, for other occurrences of this species).

1939

39. LAIMING, BORIS

Some foraminiferal correlations in the Eocene of San Joaquin Valley, California: Sixth Pacific Sci. Congr., Proc. v. 2, p. 535-568, 9 text figs. . . . Amer. Assoc. Petroleum Geologists, Bull. 24, no. 11, 1940, p. 1923-1939, 9 text-figs. (recorded as Foraminiferal correlations in Eocene of San Joaquin Valley, California).

Foraminiferal species from the Upper Cretaceous Moreno shale (see Cushman and Campbell, 1935), as well as some from Cretaceous localities outside California, are recorded from Zone E of lower Eocene or Paleocene age.

40. LEFÉBURE, P., AND CHENEVIÈRE, E.

Description et iconographie de diatomées rares ou nouvelles: Bull. Soc. Française Microscopie, v. 8 no. 1, pt. 2, p. 21-25, 1 text-fig., 1 pl.

Kittonia hannai, a new species, is described and illustrated from the Upper Cretaceous Moreno shale of Fresno County, California (sec. 6, T. 15 S., R. 12 E., M. D. B. & M.)

1940

41. DEFLANDRE, GEORGES

L'origine phylogénétique de *Lyramula* et l'évolution des Silicoflagellidées: Compte-rendus Acad. Sci., v. 211, p. 508-510, 12 figs.

Lyramula furcula var. *minor* n. var. is figured and described from the Upper Cretaceous Moreno diatomite of the Panoche Hills, Fresno County, California.

42. RAMPI, LEOPOLDO

Archaeomonadaceae del Cretaceo Americano: Atti Soc. Ital. Sci. Nat., v. 79, fasc. 1, p. 60-67.

Eleven new species of chrysomonad flagellates (*Archaeomonas semplicia, A. spinulosa, A. chiarugii, A. ambigua, A. membranosa, A. scrobiculata, A. cretacea, A. smithi, Archaeomonadopsis frenguelli, A. incerta,* and *A. elegante*) and five others—*Archaeomonas inconspicua, A. mangini, A. vermiculosa, A. heteroptera,* and *Archaeöspaeridium dangeardianum,* all described by Deflandre —are described and illustrated from the Moreno shale (in sec. 24, T. 14 S., R. 11 E., M. D. B. & M., Fresno County, California, according to Long, Fuge, and Smith, 1946).

1941

43. CUSHMAN, J. A., AND HEDBERG, H. D.

Upper Cretaceous Foraminifera from Santander del Norte, Colombia, S. A.: Contr. Cushman Lab. Foram. Res., v. 17, pt. 4, p. 79-100, pls. 21-23.

Spiroplectammina anceps (Reuss) of Cushman and Church (1929, p. 500, pl. 36, figs. 1-2) from the Upper Cretaceous near Coalinga, California, is placed in the synonymy of *Spiroplectammina semicomplanata* (Carsey). (See Lalicker, 1935.)

44. DEFLANDRE, GEORGES

Les notions de genre at de grade chez les Silicoflagellidées et la phylogenèse des mutants naviculaires: Compte-rendus Acad. Sci., v. 212, p. 100-102, 24 figs.

Vallacerta hamai n. sp. is described and figured from the Upper Cretaceous Moreno diatomite of the Panoche Hills, Fresno County, California.

45. PAYNE, M. B.

Moreno shale, Panoche Hills, Fresno County, California: Geol. Soc. America, Bull., v. 52, no. 12, pt. 2, p. 1953-1954 (Abs.).

An abundance of *Siphogenerinoides* [*S. whitei* Church, 1943] characterizes the 300 feet of white-weathering, calcareous shale of the Marca member of the Moreno (Cretaceous) formation. (See Payne, 1951, p. 11.)

46. REINHART, P. W.

Cretaceous—west side Sacramento Valley north of Willows: Amer. Assoc. Petroleum Geologists, Bull. v. 25, no. 11, p. 2095 (Abs.) . . . (Also see abstract in Oil Weekly, v. 103, no. 7, p. 57, 1941).

"The general features of the geology and stratigraphy, as determined from reconnaissance study, are discussed. Evidence is presented which indicates that the contact between the Knoxville and Franciscan is a fault having a displacement of many thousands of feet, resulting in the concealment of the basal Knoxville beds in the entire area. The stratigraphic sequence exposed along McCarthy and Elder creeks, Tehama County, is described, and the presence of occasional Foraminifera in the Mesozoic formations noted."

1942

47. CAMP, C. L.

Ichthyosaur rostra from Central California: Jour. Paleontology, v. 16, no. 3, p. 362-371, pls. 52-53, 4 text-figs.

Thin sections of a Quaternary gravel nodule (containing ichthyosaur snouts redeposited from the ?Upper Jurassic Franciscan group) from "near the mouth of Corral Hollow Creek, 1 mile southeast of "Gravel Pit" (U.S.G.S. Carbona quadrangle), and 6 miles south of Tracy, San Joaquin County" (U.C.M.P. loc. V3531) contain *Dictyomitra (Nassellaria),* possibly *D. varians* Rüst, 1888, a radiolarian.

Specimens of this latter microfossil are "much crowded together with spheroidal radiolarians *(Spumellaria)* but only 'ghosts' of these are found, a large number of which are apparently of the discoidal type, but further determination appears impractical".

48. CAMPBELL, A. S., AND CLARK, B. L.

Radiolarian fauna from the Upper Cretaceous of the Tesla quadrangle, middle California: Geol. Soc. America, Bull., v. 53, no. 12, pt. 2, p. 1835 (Abs.).

"This paper describes a radiolarian fauna (approximately 100 species) which was obtained from about 1 cubic inch of limestone, given to the writers by Dr. Arthur Huey. The sample came from near the top of a series of shales mapped by Anderson and Pack as Moreno, but these shales are somewhat older than those of the type section of the Moreno.

"Nine families are represented by 25 genera in this fauna. It may be referred to as a *Saturnalis* fauna, so called because of the prominence of that genus and of related genera. These are ring-bearing forms which are rare in Tertiary strata. No Tertiary or recent species of Radiolaria have been recognized in this fauna.

"The presence of a number of very large and generally coarse species of radiolarians; the number of many-jointed and basally fenestrated Nassellaria; the lack of delicate apophysate types; and most fortunately the association of related fossil species with loricate ciliates (*Parafavella* = *Tintinnus* sp. Rüst, 1885) similar to the recent Arctic forms which flourish at freezing temperatures indicate that this Cretaceous fauna lived in cool waters. This is in marked contrast to the tropical condition that existed during the Upper Eocene in middle California, as shown by the radiolarian fauna described recently by Clark and Campbell from beds of that age." (See Campbell and Clark, 1944).

49. DAVID, L. R.

Use of fossil fish scales in micropaleontology: Geol. Soc. America Bull., v. 53, no. 12, pt. 2,

p. 1816-1817 (Abs.) . . . Carnegie Inst. Washington Publ. 551, 1944, p. 25-43, 6 pls., 9 text-figs.

Fish scales are mentioned as occurring in the Upper Cretaceous of California.

50. GOUDKOFF, P. P.

Foraminiferal zones in the Upper Cretaceous of the Sacramento and San Joaquin Valleys, California: Amer. Assoc. Petroleum Geologists, Bull., v. 26, no. 5, p. 899 (Abs.).

"The paper deals with the Upper Cretaceous strata developed in the Sacramento and San Joaquin valleys between the latitude of the town of Corning on the north and the latitude of the Blackwell Corner on the south.

"General microfaunal characteristics, stratigraphical sequence, areal distribution, and lithological variations of the foraminiferal zones recognizable in the part of the section are described.

"One sketch map shows localities of surface outcrops and wells from which samples were obtained. Another map illustrates in a schematic way stratigraphical sequence and areal distribution of the zones."

51. THALMANN, H. E.

Globotruncana in the Franciscan limestone, Santa Clara County, California: Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1838 (Abs.).

"Thin sections of a limestone collected at the Permanente Quarry in Santa Clara County, California (Palo Alto quadrangle, secs. 17 and 18, T. 7 S., R. 2 W.), which is mapped with the Franciscan rocks in the Santa Cruz folio, contain specimens of single-keeled *Globotruncana* sp. aff. *G. appenninica* Renz and double-keeled *Globotruncana linneiana* (d'Orbigny), besides unidentifiable Globigerinae ? Lagenae (of the *L. colloni* de Lapparent type) and remains of an arenaceous form (? *Haplophragmoides)*. This limestone probably represents the correlative of the Calera limestone member of the Franciscan, as mapped in the San Francisco Bay folio (Lawson, 1914).

"The presence of the genus *Globotruncana* in the limestone of the Permanente Quarry unquestionably places this member of the Franciscan in the Upper Cretaceous. The occurrence of *Globotruncana* sp. aff. *G. appenninica* Renz associated with *G. linneiana* (d'Orbigny) leads to the conclusion that the limestone is not older than Turonian and not younger than Santonian (Lower Senonian). This age determination, based entirely on smaller Foraminifera, removes this part of the Franciscan from the Jurassic.

"Foraminiferal assemblages similar to if not identical with the one observed in thin sections of the limestone at the Permanente quarry are known to the writer from Turonian and Lower Senonian rocks in the Swiss Alps, the Isonzo region and Julian Alps, the Balearic Islands (Mallorca), the Pyrenees, and other localities within the area covered by the ancient Tethys sea in Upper Cretaceous time". (See Irwin, 1957).

52. WATSON, E. A.

Age of the Martinez formation of Pacheco syncline, Contra Costa County, California: The American Midland Naturalist, v. 28, no. 2, p. 451-456, 2 figs.

A foraminiferal faunule containing *Marginulina jonesi, M. decursecostata,* and *Silicosigmoilina californica* at locality "M-132 (430 feet below the base of the Martinez) seems to represent a Cretaceous age older than type Moreno."

Marginulina jonesi Cushman and Church, 1929, is stated to be a homonym of *Marginulina jonesi* Reuss, 1863 from the Lower Cretaceous of Europe and "should now be cited as *Marginulinopsis decursecostata* (Thalmann)." (See Thalmann, 1937).

1943

53. ANDERSON, F. M.

Synopsis of the later Mesozoic in California: *in* "Geologic formations and economic development of the oil and gas fields of California": State of California, Div. Mines Bull. 118, p. 183-186, 4 figs.

The upper part of the Moreno shale of uppermost Cretaceous age (correlative with the Maastrichtian of southwest France or western Germany) contains Foraminifera, diatomaceae, mollusks, and bones of plesiosaurs and shore dinosaurs.

54. BECKWITH, H. T.

Tracy gas field: *in* "Geologic formations and economic development of the oil and gas fields of California": State of California, Div. Mines Bull. 118, p. 586-587. 1 fig., 1 table.

The *Siphogenerinoides* zone of Moreno age (Upper Cretaceous) was encountered in the Amerada Petroleum Corp. well no. "FDL" 1 from 3,477 to 3,895 feet, the *Nodosaria spinifera* zone, also of Moreno age, from 3,895 to 5,700 feet, the *Planulina constricta* zone from 5,700 to 6,900 feet, and the *Bathysiphon taurinensis* zone from 6,900 to 9,690 feet. The latter two zones are referred to the Panoche, also of Cretaceous age.

The *Bulimina prolixa* zone, occurring at a depth of 3,199 to 3,956 feet in the Union Oil Company well No. "Tracy" 1, some 10 miles to the southeast, is missing in the Amerada test.

55. CAMPBELL, A. S.

In: WELLES, S. P., Elasmosaurid plesiosaurs with description of new material from California and Colorado: Mem. Univ. Calif., v. 13, no. 3, p. 125-254, frontis., pls. 12-29, 37 text-figs.

Sixteen or more species of Foraminifera (*Anomalina pseudopapillosa, Bulimina obtusa, Dentalina legumen, Flabelline pilulifera, Frondicularia* cf. *undulosa, Gyroidina depressa, Marginulina elongata, Nodosarella* (n. sp. Campbell) (?), *Nodosaria monile, N. pomuligera, N. spinifera, N.* (n. sp. Campbell), *N.* spp. (fragments), *Robulus inornatus, R.* sp., and *R.* (n. sp. Campbell) are listed from the shale matrix associated with a

skeleton of *Hydrotherosaurus alexandrae* Welles, a plesiosaur, from 775 feet above the base of the Upper Cretaceous Moreno Formation in sec. 13, T. 14 S., R. 11 E., M. D. B. & M., Panoche Quadrangle, Fresno County (U. C. Loc. V3735).

"This faunule approximates that at Marsh Creek, U. C. loc. A1678. It is part of the general *Bulimina obtusa* zone which is pretty well distributed all over the [North American] continent and Europe. This is supposed to be equal to the Navarro of Texas. The same faunule occurs, in poorer form, at Corral Hollow, and in the hills near Tracy (= Maestrichtian).

"It would not be too much to say that 99 percent of the collection includes *Bulimina obtusa*. The other spp. are extremely rare, save *Flabellina pilulifera* which is not uncommon."

56. CHURCH, C. C.

Descriptions of Foraminifera: *in* "Geological formations and economic development of the oil and gas fields in California": State of California, Div. Mines Bull. 118, p. 182, fig. 67-37.

Siphogenerinoides whitei Church, a new species from about 800 feet below top of the Upper Cretaceous Moreno shale (near center sec. 6, T. 15 S., R. 12 E., Panoche Hills, Fresno County) is described and illustrated.

57. CUSHMAN, J. A., AND TODD, RUTH

The genus *Pullenia* and its species: Contr. Cushman Lab. Foram. Res., v. 19, pt. 1, 23 p., 4 pls.

Pullenia quinqueloba (Reuss) of Cushman and Church (1929, p. 517, pl. 41, figs. 10, 11) from the Upper Cretaceous near Coalinga, California, is placed in the synonymy of *Pullenia americana* Cushman. It is also stated that other specimens from the Cretaceous of California probably belong here but they are compressed and distorted.

58. DAVID, L. R.

Tertiary and Cretaceous paleontology of California based on fossil fish remains: Rept. Comm. Marine Ecology as Related to Paleontology 1942-43, no. 3, Nat. Res. Council, p. 31-32.

"An abundance of [Upper Cretaceous] fish remains occurs in the Moreno and Panoche formations of the Panoche Creek area, middle Coast Ranges. The great gap known to exist between the Upper Cretaceous fish and the earliest known Tertiary forms is apparent also in California. The California Cretaceous fish are comparable to known Upper Senonian faunas. Different assemblages are present, all of which indicate fairly shallow coastal seas."

59. DURHAM, J. W.

Pacific Coast Cretaceous and Tertiary corals: Jour. Paleontology, v. 17, no. 2, p. 196-202, 2 text-figs., pl. 32.

Twenty-six species of Foraminifera are recorded (identifications by Lois T. Martin) from two depth intervals in the Cheney well #1 in SW¼ sec. 29, T. 14 S., R. 13 E., Fresno County, California. Twenty of the 26 species were found at a depth of 5,720 feet – these are: *Anomalina ammonoides*, *Bathysiphon* sp., *Bulimina brevis*, *Dentalina megalopolitana*, *Epistomina caracolla*, *Eponides haidingerii*, *Globigerina cretacea*, *Gümbelina* cf. *globulosa*, *Gyroidina globosa*, *Haplophragmoides eggeri*, *Lenticulina navicula*, *Lenticulina williamsoni*, *Nodosaria affinis*, *Robulus macrodiscus*, *R. munsteri*, *R. pseudo-secans*, *Silicosigmoilina californica*, *Spiroplectoides clotho*, *Vaginulina* sp., "*Valvulineria pachecoensis*", and 16 occur between the depths of 5,827 and 5,834– these are: *Anomalina ammonoides*, *Bathysiphon* sp., *Dentalina megalopolitana*, *Ellipsonodosaria alexanderi*, *Eponides haidingerii*, *Eponides exigua*, *Haplophragmoides eggeri*, *Lenticulina navicula*, *Marginulina* cf. *ensis*, *Modosaria nuda*, *Pseudoglandulina manifesta*, *Robulus pseudo-secans*, *Silicosigmoilina californica*, *Spiroplectoides clotho*, *Vaginulina* cf. *simondsi*, and "*Valvulineria pachecoensis*".

Between these two assemblages, at a depth of 5,800 feet, is *Flabellum fresnoensis* n. sp., a coral, which Durham refers to the Cretaceous. Miss Martin in a letter to Prof. Joseph J. Graham, Stanford University, dated April 7, 1960, writes that she would now place the two above-mentioned faunules in Goudkoff's A-2 zone of Cheneyan or Danian age. (See Goudkoff, 1945, p. 970).

60. FRIZZELL, D. L.

Upper Cretaceous Foraminifera from northwestern Peru: Jour. Paleontology, v. 17, no. 4, p. 331-353, pls. 55-57.

Siphogenerinoides clarki, described by Cushman and Campbell (1936) from Upper Cretaceous shale exposed along Marsh Creek, Contra Costa County, California, is recorded from the subsurface Mal Paso shale of the Department of Piura, and comparison of *Spiroplectammina grzybowskii* Frizzell, n. sp., also from the Mal Paso shale is made with *S. californica* (Cushman and Campbell) from the Upper Cretaceous Chico formation of central California (Cushman and Campbell, 1934). According to Frizzell, the latter species is also reported from the uppermost Cretaceous Moreno shale of central California.

61. HANNA, G. D., AND HERTLEIN, L. G.

Characteristic fossils of California: *in* "Geological formations and economic development of the oil and gas fields of California": State of California, Div. Mines Bull. 118, p. 165-182, fig. 64-4 (on p. 178) and fig. 67-37 (on p. 180, 182).

Meretrosulus gracilis Hanna, a diatom from the Upper Moreno shale (C.A.S. Loc. 943) Moreno Gulch, Panoche Hills, Fresno County, previously recorded by Hanna (1927, p. 24, pl. 3, fig. 10), is refigured.

62. KIRBY, J. M.

Upper Cretaceous stratigraphy of west side of Sacramento Valley, south of Willows, Glenn County, California: Amer. Assoc. Petroleum Ge-

ologists, Bull., v. 27, no. 3, p. 279-305, 8 text-figs. . . . (Also see Abstracts in Amer. Assoc. Petroleum Geologists, v. 25, no. 11, p. 2095 and v. 26, no. 5, p. 899, 1942; Oil Weekly, v. 103, no. 7, p. 57-58, 1941).

Well-preserved specimens of the foraminifer *Marginulina jonesi* Reuss (see Thalmann, 1937) are common and apparently diagnostic of the shale at the base of the Forbes formation (youngest member of the Upper Cretaceous Chico series). Reference is also made to the calcareous Foraminifera of the Funks formation (less abundant and not as well preserved as those in the Forbes formation) and to the abundance of Radiolaria in this same lithologic unit.

63. KIRBY, J. M.

Rumsey Hills area: *in* "Geologic formations and economic development of the oil and gas fields of California": State of California, Div. Mines Bull. 118, p. 601-605, 2 figs.

A "well-preserved foraminiferal fauna, among which *Marginulina jonesi* is common and apparently diagnostic," characterizes a 250- to 300-foot zone at the base of the Upper Cretaceous Forbes formation (Chico group).

64. KNOX, G. L.

McDonald Island gas field: *in* "Geologic formations and economic development of the oil and gas fields of California": State of California, Div. Mines Bull. 118, p. 588-590, 1 fig.

Foraminifer-bearing dark-gray to brown shales interbedded with fine gray sands containing fish scales were encountered in the Cretaceous of the Weyl-Zucherman well No. 2.

65. SCHENCK, H. G.

Acila princeps, a new Upper Cretaceous pelecypod from California: Jour. Paleontology, v. 17, no. 1, p. 60-68, pls. 8-9; 2 text-figs. (including geologic map).

A foraminiferal faunule containing *Globotruncana arca* (Cushman) is reported by C. F. Green as occuring approximately 850 feet stratigraphically below the lower Tierra Loma shale member of the Upper Cretaceous Moreno formation in sec. 13, T. 12 S., R. 10 E., Merced County (S.U. Loc. M-260). "Some geologists believe that the beds carrying these fossils should be allocated to the Panoche formation, whereas others place them in the lower Moreno". Green has also reported a "faunule with abundant specimens of *Bulimina prolixa* Cushman and Parker, *Siphogenerinoides whitei* Church, and other species" from near the base of the Tierra Loma shale at M-261 in NE¼ sec. 13, T. 12 S., R. 10 E.

Siphogenerinoides whitei Church, which occurs in shale 260 ± feet stratigraphically above the pelecypod *Acila (Truncacila) princeps* Schenck, n. sp., is stated as being closely related to *Siphogenerinoides cretacea* Cushman from the lower Colon shale (possibly Campanian) of Venezuela. It is the foraminiferal faunule in this superjacent shale that warrants correlation with at least a part of the type of Tierra Loma.

66. THALMANN, H. E.

Upper Cretaceous age of the "Franciscan" limestone near Laytonville, Mendocino County, California: Geol. Soc. America, Bull. v. 54, no. 12, p. 1827 (Abs.).

"Microscopic study of a reddish, slightly siliceous limestone, collected by N. L. Taliaferro in 1939 from outcrops about 200 yards east of the Redwood Highway, 2 miles north of Laytonville, Mendocino County, California (Stanford Univ. Coll. Sta. M-375), disclosed the presence of a foraminiferal assemblage consisting of *Globotruncana renzi* Thalmann, *Globigerina cretacea* d'Orbigny, small *Gümbelina* sp., *Bolivina* sp., *Astacolus* ? sp., *Nodosaria* sp., *Rotalia* ? sp., and other difficultly identifiable forms. The *Globotruncana* species is abundant in all sections made from this limestone and clearly indicates at least a Turonian age for the so-called "Franciscan" limestone at Laytonville.

"The Laytonville limestone, therefore, is to be regarded as a synchronous deposit of the Calera limestones of the quarries of the Permanente Cement Company, Santa Clara County, and of the Calera limestone at its type locality in Calera Valley, San Mateo County, California. Identical foraminiferal assemblages of Turonian age have also been detected in the Calera limestone outcropping between Bolinas and Olima [Olema], Marin County, California, and in the Whitsett limestone at the south fork of Deer Creek, and on a branch of Roberts Creek, Douglas County, Roseburg quadrangle, Oregon. All these limestones, hitherto placed in the Franciscan formation and regarded as Upper Jurassic, must now be attributed to the Upper Cretaceous (Turonian stage). This new age assignment of several limestone intercalations in the Franciscan formation is likely to throw a new light on the geological history of the Franciscan-Knoxville geosyncline in California". (See Irwin, 1957).

67. TOLLMAN, F. B.

Potrero Hills Gas Field: *in* "Geologic formations and economic development of the oil and gas fields of California": State of California, Div. Mines Bull. 118, p. 595-598, 2 figs.

Cretaceous rocks in the discovery well, Richfield Oil Corporation's No. "Potrero" 1, are assigned to Goudkoff's *Marginulina jonesi* zone ("lower Panoche").

68. WILSON, I. F.

Geology of the San Benito quadrangle, California: California Jour. Mines and Geology, v. 39, no. 2, p. 183-270, 30 text-figs., pls., (incl. geol. map) . . . Geol. Soc. America Bull., v. 52, no. 12, pt. 2, 1941, p. 1960 (Abs.).

Notes:

(1) the abundance of Foraminifera in the Panoche Group (Upper Cretaceous), particularly

in the Paynes shale and sandstone member on Paynes Creek (17 species—*Bathysiphon, Dentalina communis, Eponides haidingerii, Gaudryina crassaformis, Glandulina manifesta, Globotruncana arca, Gyroidina* sp., *Lenticulina navicula, L. sublaevis, L. williamsoni, Marginulina decurse-costata, Marssonella oxycona, Nodosaria affinis, Robulus velascoensis, Spiroplectammina anceps, Stensoina* cf. *excolata, Ventilabrella ornatissima;* on Salt Creek (6 species—*Bolivina incrassata* ?, *Bolivinopsis clotho, Bulimina trinitatensis, Gaudryina crassaformis, Gyroidina* cf. *florealis, Silicosigmoilina californica* plus unidentified arenaceous forms); in the Butts Ranch shale member along Paynes Creek 1 mile north of Butts Ranch (18 species—*Anomalina* cf. *rubiginosa, Bolivina incrassata, Bulimina obtusa, Epistomina caracolla, Eponides haidingerii, Gaudryina crassaformis, Globotruncana arca, Gyroidina depressa, Haplophragmoides eggeri, Lenticulina williamsoni, Marssonella oxycona, Nodosaria ewaldi, Nodosaria* cf. *spinifera, Planulina* cf. *schloenbachi, Pullenia coryelli* var., *Silicosigmoilina californica, Spiroplectammina anceps,* and *Ventilabrella ornatissima* indicative of the Panoche, and definitely older than the type Moreno assemblage according to Louis Simon, C. C. Church, Max B. Payne, and Robert T. White); and in the Big Oak Flat member 1 mile northwest of Big Oak Flat (17 species—*Arenobulimina* ?, *Bathysiphon, Bulimina, Gaudryina, Globigerina, Glomospira charoides, Haplophragmoides, Marssonella* ?, *Nonion* ?, *Plectina* cf. *irregularis, Pullenia, Silicosigmoilina californica, Spirillina vivipara, Spiroloculina cretacea, Spiroplectammina dentata, Trochammina globigeriniformis, Trochamminoides,* and ? *Lithostrobus,* a radiolarian)—this last faunule, according to Louis Simon, may be "from the Upper Cretaceous probably not older than basal Coniacian".

(2) the abundance of *Siphogenerinoides* (*S.* cf. *whitei*) and 4 other species in the Upper Cretaceous Moreno shale [this unit corresponds to the Marca shale member of the Moreno at the type locality according to H. G. Schenck and M. B. Payne] along the northeast side of Butts Ranch syncline.

All the above-mentioned localities are in San Benito County.

1944

69. CAMPBELL, A. S., AND CLARK, B. L.

Radiolaria from Upper Cretaceous of middle California: Geol. Soc. America Special Papers 57, viii + 61 p., 8 pls., 2 figs. . . . (Also see abstract in Geol. Soc. America Bull., v. 53, no. 12, pt. 2, 1942, p. 1835.

"This paper describes a radiolarian fauna [86 species and varieties] obtained from a small limestone sample which came from the top of a series of shales from near Tesla [sec. 31, T. 3 S., R. 4 E., U.C.M.P. Loc. A2615, Alameda County] California, and is probably older than Moreno.

"The fauna may be referred to as a *Saturnalis* or *Dictyomitra* fauna, so-called from the prominence of these and related genera. No recent or Tertiary species have been recognized in this fauna; all but two species are new. There are three (3) new genera [erroneously reported as two] among the *Spumellaria* [*Spongosaturnalis, Spongosaturninus,* and *Heliosestarium*] and one of the Nassellaria [*Rhopalosyringium*]. This is the most extensive Cretaceous radiolarian fauna recorded from North America.

"The presence of a number of large species of coarse texture, of many-jointed and basally fenestrated Nassellaria, the lack of delicately apophysate types, and the association of generally similar species in the Alpine Jurassic with ciliates (*Parafavella* spp.) suggest the possibility that this was a cool-water fauna, in sharp contrast with the upper Eocene tropical faunas of Middle California recently described by us." (Found with the Radiolaria was *Lytoceras (Tragonites)* aff. *epigonas* (Kossmat), an ammonite, which F. M. Anderson states is very common in beds locally known as the *Pachydiscus* silts = Campanian, Upper Senonian).

Also listed are nine species and one variety of Foraminifera—*Bulimina obtusa, B. spinata, Eponides umbonella, Gaudryina navarroana* var., *Globigerina* cf. *triloba, Globotruncana arca, Gyroidina depressa, Nodogenerina lepidula, Nodosaria monile,* and *Nodosaria* sp. These occur in the upper portion of the Corral Hollow shales now termed Moreno Grande) of the Tesla area, near the same horizon in which the Radiolaria occur.

Several of the Foraminifera, including *Nodosaria* sp. (?) and *Nodosaria* cf. *velascoensis* (not listed in above fauna), are silicified. These occur in limestone along with Radiolaria and are correlated with a similar fauna in cores from wells near Tracy.

70. CUSHMAN, J. A., AND GOUDKOFF, P. P.

Some Foraminifera from the Upper Cretaceous of California: Contr. Cushman Lab. Foram. Res., v. 20, pt. 3, p. 53-64, pls. 9-10.

Twenty-eight species and varieties (9 species and 2 varieties are new—*Bathysiphon perampla, Haplophragmoides eggeri* Cushman var. *minuta, H. colusaensis, Cribrostomoides cretacea, Gaudryina rudita* Sandidge var. *diversa Marginulina curvisepta, Siphogenerinoides clarki* Cushman and Campbell var. *costifera, Reussella californica, Valvulineria orolomaensis V. lillisi,* and *Eponides ingramensis*) are described and figured (see Mayne, 1952; Avnimelech, 1952, for taxonomic changes) from various California Upper Cretaceous areas (embracing the Chico series as defined by F. M. Anderson, 1941, Calif. Div. Mines, Bull. 118, p. 183, 185) in Alameda, Colusa, Fresno, Glenn, Merced, Solano, Sutter, Stanislaus, and Yolo counties.

Included in the assemblage are the following forms (some of which have previously been reported from California): *Amphimorphina* (?)

sp., *A.* cf. *A. clementiana, Anomalina henbesti, Bulimina petroleana, B. prolixa, Cibicides* cf. *coonensis, C. stephensoni, Cribrostomoides* (?) sp., *Dentalina megalopolitana, Gaudryina* (*Pseudogaudryina*) *pyramidata, Globotruncana canaliculata, Globulina lacrima* var. *subsphaerica, Gyroidina globosa, Planulina nacatochensis, Planularia tricarinella, Plamularia* sp., *Siphogenerinoides whitei.* Some of the species are from wells.

The Foraminifera "seem to belong to the species most important for recognition" of the 13 foraminiferal zones into which the Upper Cretaceous (Chico) has been divided.

In addition to the section, township, and range for each locality the stratigraphical positions of samples carrying the species are given in reference to the top of the Moreno shale.

71. DEFLANDRE, GEORGES

Remarques sur l'évolution des Silicoflagellidées, à propos de deux espèces crétaciques nouvelles: Compte-rendus Acad. Sci., v. 219, p. 463-465, 9 figs.

Cornua aculeifera, n. sp., from the Upper Cretaceous Moreno diatomite of the Panoche Hills, Fresno County, California, is described and figured.

72. HERTLEIN, L. G., AND GRANT, U. S. IV.

The geology and paleontology of the marine Pliocene of San Diego, California: Mem. San Diego Soc. Nat. Hist., v. 2, pt. 1, Geol., 72 p., 17 pls., 2 text-figs.

Ten foraminiferal species (*Anomalina* sp., *Allomorphina* cf. *minuta, Bulimina obtusa, Globotruncana arca, Gyroidina* sp., *Gaudryina* (*Pseudogaudryina*) *pyramidata G. oxycona, Marginulina humilis, Robulus* sp., and *Spiroplectammina anceps*) are listed from near the middle of the Upper Cretaceous dark gray shale (below Moreno and probably in the upper half of the Panoche group of F. M. Anderson) at the extreme south end of Point Loma (C.A.S. Loc. 1173). Also, three foraminiferal genera (*Textularia, Silicosigmoilina,* and *Marginulina*), which may be of Cretaceous age, were found at a depth of 2000′ in the Borderland Exploration Company well Point Loma #1 (sec. 30, T. 16 S., R. 3 W., S. B. B. & M., San Diego County).

73. SHIMER, H. W., AND SHROCK, R. R.

Index fossils of North America: John Wiley and Sons, Inc., New York, x + 837 p., 303 pls.

Descriptions and illustrations are given of the silicoflagellate genera *Corbisema, Lyramula,* and *Vallacerta* of Hanna, 1928 and the foraminiferal genus *Silicosigmoilina* Cushman and Church, 1929 from the Upper Cretaceous of California.

74. STEWART, RALPH, POPENOE, W. P., AND SNAVELEY, P. D. JR.

Tertiary and late Upper Cretaceous stratigraphy of west border of San Joaquin Valley, north of Panoche Creek, Fresno, Merced, and Stanislaus Counties, California: U. S. Geol. Surv., Oil and Gas Investig. Prelim. Chart 6.

References are made to (1) the reported occurrence of Cretaceous Foraminifera, particularly to the abundance of impressions of *Siphogenerinoides,* in weathered slabs of the white shale (Marca) of the Upper Cretaceous Moreno formation in Panoche Hills (Fresno County), and (2) the presence of *Siphogenerinoides* "in a dark shale probably higher stratigraphically than the white shale" in the Laguna Seca area, Merced County.

75 TALIAFERRO, N. L.

Cretaceous and Paleocene of Santa Lucia Range, California: Amer. Assoc. Petroleum Geologists, Bull., v. 28, no. 4, p. 449-521, 18 text-figs. (including geologic maps and paleogeologic map of California near close of Cretaceous), 3 tables.

Six species of Foraminifera *(Bulimina prolixa, Haplophragmoides* sp., *Pahmula* cf. *pilulifera, Robulus macrodiscus, Silicosigmolina californica,* and *Siphogenerinoides* cf. *clarki)* are listed from two Upper Cretaceous (Asuncion formation) localities (with a stratigraphic separation of about 300 feet) along the north bank of Nacimiento River in NE¼, NE¼ sec. 19, T. 25 S., R. 10 E., (Adelaida quadrangle, San Luis Obispo County), and in the SW¼, SE¼ sec. 18, T. 25 S., R. 10 E. (Bradley quadrangle, San Luis Obispo County). According to Lois T. Martin, the age of these faunules is approximately the same as that of the Moreno shale north of Coalinga. Stanley Carlson, who also checked the faunules, states that he "would compare the samples with those we have found in the lower part of the Moreno formation and the very uppermost part of the Panoche".

It is also noted that "some Asuncion shales contain abundant foraminifera and it should be possible to zone that part of the formation largely made up of shale on this basis".

1945

76. CUSHMAN, J. A.

The species of the subfamily Reussellinae of the foraminiferal Family Buliminidae: Contr. Cushman Lab. Foram. Res., v. 21, pt. 2, p. 23-54, pls. 5-8.

Notes resemblance of *Reussella californica* Cushman and Goudkoff from the Upper Cretaceous of Solano County, California (1944, p. 59, pl. 10, figs. 3-5) to *R. cushmani* Brotzen from the lower Senonian of Sweden.

77. GLAESSNER, M. F.

Principles of micropaleontology, Melbourne University Press, U.S.A. edition 1947, John Wiley and Sons, Inc., xvi + 296 p., 14 pls., 64 figs.

"Even in an incompletely known fauna from a remote area such as that of the California Upper Cretaceous, the differences between the Lower Senonian "Chico"-fauna (Cushman and Church 1929) and the Upper Senonian (Maestrichtian) Moreno-fauna (Cushman and Campbell, 1935

correspond closely to the differences found between faunal assemblages of similar age from European type sections."

78. GOUDKOFF, P. P.

Stratigraphic relations of Upper Cretaceous in Great Valley, California: Amer. Assoc. Petroleum Geologists, Bull., v. 29, no. 7, p. 956-1007, 17 figs., 2 tables.

"The paper deals with the Upper Cretaceous beds of the Sacramento and San Joaquin valleys between the latitude of Redding on the north and the latitude of Lost Hills on the south. On the basis of foraminiferal study of a number [18] of surface sections [and 4 other localities] and of core samples obtained from 128 wells the Upper Cretaceous strata of the Great Valley have been divided into twelve zones [indicated by capital letters], four of which are assumed to be represented each by two different ecological facies. The zones are grouped into seven stages [the two uppermost ones—Upper and Lower Cheneyan of pre-Martinez Paleocene age]. Foraminiferal and lithologic characteristics of the zones, their areal distribution, and stratigraphic relations are discussed and illustrated by cross sections and a diagrammatic map. Another map shows contours of the Cretaceous surface. Eight small-scale maps elucidate paleogeography of the zones and their ecological variations." (Abstract).

A total of sixty-seven species and varieties of Foraminifera are listed from 10 of the 12 zones and their ecological variants (the microfaunas of zones A-1, Upper Cheneyan stage, and H, Delevanian stage are not given), and of these, zone A-2 (Lower Cheneyan stage of Pre-Martinez Paleocene age) contains 13 species and varieties of which only 6 are of "characteristic" occurrence *(Bulimina* cf. *B. triangularis, Cibicides* cf. *C. ungeriana, Robulus* sp. *Spiroplectoides clotho, Vaginulina (Marginulina)* cf. *M. plummerae*, and *Valvulineria lillisi;* A^1–2 (Cheneyan stage) is featured by 7 species, 3 of which are "characteristic" *(Bulimina* cf. *B. triangularis, Robulus* sp., and *Valvulineria orolomaensis);* zone B (Upper Cervian stage) has 2 species *(Spiroplectoides clotho* and *Gaudryina filiformis)*, both of "characteristic occurrence"; zone C (Lower Cervian stage) is marked by 9 species, 4 of which are of "characteristic occurrence" *(Anomalina* cf. *A. clementiana, Bulimina prolixa, Planulina nacatochensis*, and *Siphogenerinoides whitei;* C^1 (Lower Cervian stage) possesses 7 species, only 2 of which are "characteristic" *(Bulimina prolixa* and *Planulina nacatochensis);* zone D-1 (Upper Ingramian stage) has 13 species and varieties, 6 of which are of "characteristic occurrence" *(Bulimina petroleana, Gyroidina globosa, Siphogenerinoides clarki* var. *costiferi, S. clarki, Cibicides* cf. *C. coonensis*, and *Eponides ingramensis);* zone D-2 (Lower Ingramian stage) contains 19 foraminifers, 12 of which have "characteristic occurrence" *(Bulimina petroleana, Flabellina pilulifera, Globulina lacrima* var. *subsphaerica, Gaudryina navarroana* var. *crassaformis, Globotruncana arca, Nodosaria spinifera, Anomalina* cf. *A. rubignosa, Bulimina spinata, Marginulina* cf. *M. bronni, Marginulina elongata, Marginulina striato-carinata*, and *Ventilabrella ornatissima);* zone E (Tracian stage) has 21 species, only 5 of which are "characteristic" *(Globotruncana arca, Bulimina obtusa, Anomalina henbesti, Gyroidina subangulata*, and *Marssonella oxycona);* zone E^1 (Tracian stage) contains 11 forms, of which *Epistomina caracolla, Dentalina megapolitana*, and *Haplophragmoides colusaensis* are "characteristic"; zone F-1 (Upper Weldonian stage) has 24 recorded species and varieties, 8 being "characteristic" *(Bathysiphon taurinensis, Ammodiscoides turbinatus, Cribostomoides cretacea, Cribrostomoides* (?) sp. *Gaudryina rudista* var. *diversa, Haplophragmoides eggeri* var. *minuta, Nodellum* sp., and *Trochamminoides proteus);* zone F^1–1 (Upper Weldonian stage) likewise has 8 "characteristic" species and varieties out of its 26 foraminifers, these are *Chrysalogonium cretaceum, Guembelina globulossa, Bathysiphon alexanderi, Marginulina jarvisi, Cribrostomoides cretacea, Cribrostomoides* (?) sp., *Gaudryina rudista* var. *diversa, and Marginulina curvisepta);* zone F-2 (Lower Weldonian stage) possesses 27 species and varieties, the greatest number of any zone, and of these 8 are "characteristic" *(Eponides spinea, Cribrostomoides cretacea, Cribrostomoides* (?) sp., *Gaudryina rudista* var. *diversa, Haplophragmoides eggeri* var. *minuta, Bathysiphon perampla, Gyroidina florealis*, and *Trochammina* sp.; zone G-1 (Upper Cachenian stage) contains 26 species and varieties and of these 11 are of "characteristic occurrence" *(Gyroidina quadrata, Globotruncana canaliculata, Eponides umbonella, Marginulinopsis decursecostata, Gaudryina pyramidata, G. retusa, Stensoina excolata, Amphimorphina* sp., *Planularia tricarinella, Pleurostomella* cf. *P. subnodosa*, and *Reussella californica);* and zone G-2 (Lower Cachenian stage) has 17 recorded fossils, of which 10 are listed as being "characteristic" *(Globotruncana canaliculata, Eponides umbonella, Gaudryina pyramidata, G. retusa, Stensoina excolata, Amphimorphina* sp., *Planularia tricarinella, Pleurostomella* cf. *P. subnodosa, Cibicides stephensoni*, and *Vaginulina* cf. *V. kochii.*

Table 1 shows, in part, the tentative correlation of the Ciervian, Ingramian, and Tracian stages with the Navarro, the Weldonian stage with the Taylor, the Cachenian stage with the Eagle Ford, and the Delevanean stage with the Woodbine, all groups of the Texas Cretaceous.

1946

79. ALLEN, J. E.

Geology of the San Juan Bautista Quadrangle, California: State of California, Div. Mines. Bull. 133, p. 9-75, 8 pls., plus 3 pls. in pocket, 10 text-figs. . . . Geol. Soc. America Bull., v. 56, no. 12, pt. 2, 1945, p. 1143 (Abs.).

Numerous cross sections of Foraminifera, Radiolaria, and Bryozoa are reported from a thin-

bedded gray sandstone of Franciscan age (Upper Jurassic?) ½ mile west of Castro Flats in Santa Clara County, and small indeterminate structures, possibly of large Foraminifera, are mentioned as characterizing the weathered surfaces of various Franciscan limestone outcrops.

80. CUSHMAN, J. A.

Upper Cretaceous Foraminifera of the Gulf Coastal Region of the United States and adjacent areas: U. S. Geol. Surv. Prof. Paper 206, iii + 241 p., 66 pls.

References to publications of forms from the Upper Cretaceous of California are listed in the synonymies of various species.

81. DAVID, L. R.

Upper Cretaceous fish remains from the western boarder of the San Joaquin Valley, California: Carnegie Inst. Washington Publ. 551, Contributions to Paleontology, p. 81-112, 3 pls. 11 figs.

Eight new genera *(Laimingia, Kleinpellia, Driverius, Natlandia, Goudkoffia, Rankinia, Paraberyx,* and *Rothwellia),* and eleven (11) new species *(Holcolepsis nodulatus, H. angulatus, Laimingia plicata, Kleinpellia morenoensis, Driverius cretaceus, Natlandia ornata, Goudkoffia delicata, ? Sardinioides californicus, Rankinia macrouriformis, Paraberyx californica, Rothwellia trachichthyiformis),* as well as 8 other fish species, an *incertae sedis* fish form and others referred to *Kleinpellia* are described and figured from the Upper Cretaceous Moreno and Panoche formations.

"The core samples in which the fish remains [mostly scales] occur were taken from the following wells: (1) Jergins Oil Company, Chaney Ranch No. 1, Panoche district, Sec. 29, T. 14 S., R. 13 E., [Fresno County] Mount Diablo base line and meridian, total depth 9284 feet; (2) Western Gulf Oil Company, Lillis Welch No. 1, Firebaugh district, Sec. 26, T. 15 S., R. 12 E., [Fresno County] Mt. Diablo B. and M., total depth 5624 feet; (3) Pure Oil Company, Chowchilla No. 1, Chowchilla district, Sec. 7, T. 10 S., R. 14 E., [Madera County] Mt. Diablo B. and M., total depth 8387 feet. Included in the report are also some large fish remains found in the Moreno formation of the Panoche Hills. From these deposits have come also remains of mosasaurs and plesiosaurs."

82. LONG, J. A., FUGE, D. P., AND SMITH, JAMES

Diatoms of the Moreno shale (Introduction by G. D. Hanna): Jour. Paleontology, v. 20, no. 2, p. 89-118, pls. 13-19, 1 fig. (Outline map of portion of the Panoche quadrangle).

Three new genera, *Mammidion, Rhapidophora,* and *Upothema,* 67 new species, 11 new varieties, and 41 other species and varieties are described and illustrated from the Moreno formation [Marca shale member] of Upper Cretaceous age along the east flank of Panoche Hills, north of Panoche Creek, sec. 24, T. 14 S., R. 11 E., M. D. B. & M.; western Fresno County, California. This locality is close to that from which Church (1943) described *Siphogenerinoides whitei.*

Pertinent information on the geographical extent, geological relationships, and some physical aspects of the Moreno shale are given in the *Introduction.*

It is also stated that the foraminiferal faunule described by Cushman and Campbell (1935) from the Moreno near Tracy is now considered by some workers to be Panoche.

83. STONE, BENTON

Siphogenerinoides Cushman (Order Foraminifera, Family Buliminidae): Jour. Paleontology, v. 20, no. 5, p. 463-478, pls. 71-72, 4 text figs.

Descriptions of *Siphogenerinoides clarki* Cushman and Campbell, 1936, *S. whitei* Church, 1943, and *S. clarki costifera* Cushman and Goudkoff, 1944, from the Upper Cretaceous of California are given, and references to the typical *Siphogenerinoides* aperture of these fossils are made.

1947

84. CUSHMAN, J. A.

A foraminiferal fauna from the Santa Anita formation of Venezuela: Contr. Cushman Lab. Foram. Res., v. 23, pt. 1, p. 1-18, 4 pls.

The Upper Cretaceous assemblage includes *Chrysalogonium cretaceum* Cushman and Church (1929) described from the Upper Cretaceous near Coalinga, California, and *Bulimina petroleana* Cushman and Hedberg, a species which occurs at various California localities.

85. CUSHMAN, J. A., AND PARKER, F. L.

Bulimina and related genera: U. S. Geol. Surv. Prof. Paper 210-D, ii + 55-176 p., pls. 15-30.

A questionable occurrence of the foraminifer *Bulimina kickapooensis* Cole in the Upper Cretaceous Moreno shale of California is noted, and description and illustration of *Bulimina spinata* Cushman and Campbell from the Moreno shale (previously recorded by Cushman and Campbell 1935, p. 72, pl. 11, figs. 11) are included.

1948

86. CUSHMAN, J. A., AND TODD, RUTH

A foraminiferal fauna from the New Almaden district, California: Contr. Cushman Lab. Foram. Res., v. 24, pt. 4, p. 90-98, pl. 16 (figs 4-25).

Nineteen species (including 12 which are new: *Textularia ? almadenensis, Gaudryina almadenensis, Pseudoclavulina californica, P. almadenensis, P. coria, Dorothia ? almadenensis, Tritaxilina ? almadenensis, Globigerina almadenensis, Globorotalia californica, G. decorata, G. almadenensis* and *Planomalina ? almadenensis*)—mostly from crumbly material near the contacts of limestone beds (Calera) and greenstone tuffs of the Franciscan group—are described and figured from SW¼ sec. 24, T. 8 S., R. 1 W., M.D.M., (Los Gatos quadrangle), Santa Clara County. Seven

of the 19 foraminifers are not specifically identified (*Arenobulimina* sp., *Bolivina* sp., *Bulimina* sp., *Gyroidina* sp., *Eponides* sp., *Globigerina* sp., and *Hastigerinella* sp.,), but of the 14 genera recognized, six "are known from beds as old as Jurassic or older, one from Lower Cretaceous beds only, five from beds not older than Lower Cretaceous, and two from beds not older than Upper Cretaceous".*

As no foraminiferal species of zonal significance in the Upper Cretaceous of California were found by the authors, they conclude that it is best to refer this material to the Lower Cretaceous. (Glaessner, 1949, postulated a late Lower Cretaceous (Albian) age, Küpper, 1955, an early or medial Cenomanian age, and Loeblich and Tappan, 1959, a lower Upper Cretaceous (mid- to upper Cenomanian) age for the "Franciscan" series of the New Almaden district).

87. HUEY, A. S.

Geology of the Tesla quadrangle, California: State of California, Div. Mines. Bull. 140, 75 p., 3 text-figs., 11 pls. (including geologic map).

Eleven species of Foraminifera (see Campbell and Clark, 1944, for partial list) and a few Radiolaria are recorded from a shale sample in the Upper Cretaceous Moreno Grande formation in sec. 27, T. 3 S., (erroneously reported as T. 35 S.), R. 3 E., Alameda County. The "fauna would appear to fall in Goudkoff's D-2 zone and be correlative with the *Pachydiscus* silt in the Coalinga region."

Well-preserved Radiolaria (see Campbell and Clark, 1944), some diatoms, and outlines of foraminifers were also observed in a limestone concretion weathered from the Moreno Grande in sec. 31, T. 3 S., R. 4 E., San Joaquin County (U.C.M.P. Loc. A-2615).

1949

88. CUSHMAN, J. A., AND TODD, RUTH

Species of the genera *Allomorphina* and *Quadrimorphina:* Contr. Cushman Lab. Foram. Res., v. 25, pt. 3, p. 59-72, pls. 11-12.

Foraminifers "very similar [to *Allomorphina cretacea* Reuss from the Upper Cretaceous of Lemberg, The Netherlands] occur in the Upper Cretaceous of California but are unlike the specimens referred to it by Cushman and Church" (1929, p. 517, pl. 41, figs. 12, 13).

89. GLAESSNER, M. F.

Foraminifera of Franciscan (California): Amer. Assoc. Petroleum Geologists, Bull., v. 33, no. 9, p. 1615-1617.

A late Lower Cretaceous (Albian) age is postulated for the foraminiferal assemblage described by Cushman and Todd (1948) from "a limestone member of the Franciscan" in the New Almaden area of Santa Clara County. This age designation is based on the close relationship of the California fauna with an Albian assemblage from Italy. (See Küpper, 1955; and Loeblich and Tappan, 1959).

90. STEWART, RALPH

Lower Tertiary stratigraphy of Mount Diablo, Marysville Buttes, and west-central border of lower Central Valley of California: U. S. Geol. Surv., Oil and Gas Investig. Prelim. Chart 34 (in 2 sheets).

Cretaceous Foraminifera are recorded from the Ulatis and Sweeney Creeks section, north of Vacaville, the Putah Creek (north side) section, Shell Oil Co. well Lambie No. 2 in the Kirby Hills, and the Black Hills section of Mt. Diablo Park (*Cibicides excolata* only); and Radiolaria from the Cretaceous of the Standard Oil Co. of California well Peter Cook No. 1 and from float in Mitchell Ravine of the Corral Hollow section.

Also, Goudkoff's (1945) foraminiferal zones are listed as being represented in various sections.

91. WEAVER, C. E.

Geology of the Coast Ranges immediately north of the San Francisco Bay region, California: Geol. Soc. America Mem. 35, ix + 242 p., 14 pls., 2 figs. . . . Summarized as State of California, Div. Mines Bull. 149, 135 p., 1949.

In discussing the close of Chico time, the writer states: "The altitude of adjacent land areas seems to have been lower so that coarse sandy and gravelly materials were replaced by clay shale and organic shale. Foraminifera, diatoms, and Radiolaria thrived in these waters or were carried in from the ocean."

The Foraminifera in the limestones and Radiolaria in the cherts of the Franciscan, according to the author, establish no definite geologic age for this group of rocks.

1950

92. ASANO, KIYOSHI

Upper Cretaceous Foraminifera from Japan: Pacific Science, v. 4, no. 2, p. 158-163, 1 pl.

Silicosigmoilina futabaensis, a new species from Fukushima Prefecture, island of Honshu, is stated to occupy "a position in the Japanese assemblage comparable to that of" *S. californica* Cushman and Church of the Upper Cretaceous of California, but differs from this latter fossil in having "a more compressed test."

Also in the Honshu fauna is *Robulus lepidus*, which is identified with a form from the Cushman and Church (1929) locality.

93. ASANO, KIYOSHI

Cretaceous Foraminifera from Teshio, Hokkaido: Short Papers, Inst. Geol. and Paleo., Tohoku Univ., Sendai, p. 13-22, 1 pl., 1 table.

Similarity of *Bathysiphon perampla* Cushman and Goudkoff (1944), "a characteristic species of the Chico series (Upper Cretaceous) of California" to *Bathysiphon sakuensis* Asano n. sp., from the Saku sandstone is mentioned. (See Avnimelech, 1952).

* (See Kupper, 1955, p. 114-117 for nomenclatural changes.)

94. DEFLANDRE, GEORGES

Contribution à l'étude des Silicoflagellidés actuel et fossiles: Microscopie, v. 2, 82 p., 243 figs.

Comparison is made of species from the Upper Cretaceous of California with those from the Senonian of Prussia. The systematic portion of the paper gives a review of the known Cretaceous species of the world, including those reported from the Moreno [Marca shale] formation of California.

95. FRIZZELL, D. L., AND SCHWARTZ, ELY

A new lituolid foraminiferal genus from the Cretaceous, with an emendation of *Cribrostomoides* Cushman: Bull. Univ. Missouri, School Mines and Metall., Tech. Ser., no. 76, 12 p., 1 pl., 1 text-fig., 2 tables.

Cribrostomoides cretacea Cushman and Goudkoff (1944) from the Chico "series" (Upper Cretaceous) of California is placed in *Barkerina* Frizzell and Schwartz, new genus. (see Mayne, 1952, p. 44-45; Smout, 1956, p. 343).

96. WALKER, G. W.

The Calera limestone in San Mateo and Santa Clara counties, California: State of California, Div. Mines, Special Rept. 1-B, 8 p., 6 figs., 1 pl.

Refers to foraminiferal studies of the Calera limestone and similar limestones in the Permanente quarry and the New Almaden area by Thalmann (1942), Cushman and Todd (1948), and others.

1951

97. BANDY, O. L.

Upper Cretaceous Foraminifera from the Carlsbad area, San Diego County, California: Jour. Paleontology, v. 25, no. 4, p. 488-513, 4 pls., 2 text-figs., 2 tables.

Fifty-six species and varieties of Foraminifera are described and figured from shale of Campanian age in the northwestern part of San Diego County (U. S. C. Loc. 116, on the Irwin J. Kelley Ranch, about 5 miles south of Carlsbad), and of these fourteen are new—*Gaudryina arguta, Bermudezina extans, Robulus modestus, Saracenaria subglobosa, Marginulina similis* Orbigny var. *obliquinodus, Lagena acuticosta* Reuss var. *brevipostica, L. acuticosta* Reuss var. *proboscidialis, Valvulineria nonionoides, Gyroidina globosa* (Hagenow) var. *orbicella, Cibicidina californica, Planulina mascula, P. multipunctata, Colomia californica,* and *C. californica* var. *mundula.* The fauna correlates with that of the Tracian stage (*Anomalina henbesti,* Zone E of Goudkoff) from the Great Valley of California and with the uppermost Taylor beds of the Gulf Coast. The Campanian age is based on the presence of *Globotruncana arca* (Cushman), the absence of typical Maastrichtian foraminiferal species and the fact that the Taylor beds are generally correlative with the Campanian of Europe. The Carlsbad fauna is listed as representing a middle (?) neritic zone.

Table 1 shows the percentage occurrences of the Kelley Ranch fauna and the stratigraphic ranges of its element in the Upper Cretaceous of the Gulf Coast, Table 2 the most abundant forms with their reported ranges in the Great Valley of California, and Figure 2 the correlation of Californian Upper Cretaceous stages and sub-stages with those of the Upper Cretaceous of Europe. (See Harris and McNulty, 1956.)

98. HANNA, G. D.

Diatom deposits: *in* Geologic guidebook of the San Francisco Bay Counties: State of California, Div. Mines Bull. 154, p. 281-290, 6 figs.

Diatom species from the Upper Cretaceous Moreno formation of California are illustrated in figure 6.

99. NOTH, RUDOLPH

Foraminiferen aus unter-und oberkreide des Osterreichischen anteils an flysch, Helvetikum und Vorlandvorkommen: Jahrb. Geol. Bundesanstalt, 91 p., 9 pls., 2 tables.

The paratypes of *Reussella californica* Cushman and Goudkoff (1944, p. 59, pl. 10, figs. 4 and 5) are placed in the synonymy of *Reussella szajnochae* and the holotype (fig. 3) is made a subspecies *(R. szajnochae californica)* of *R. szajnochae.* The latter foraminifer is listed as being restricted to the Campanian, and the former, according to the author, has a Campanian to the Maastrichtian range.

100. PAGE, B. M., MARKS, J. G., AND WALKER, G. W.

Stratigraphy and structure of mountains northeast of Santa Barbara, California: Amer. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1727-1780, 16 text-figs.

Eleven species of Foraminifera *(Globotruncana arca, Anomalina* sp., *Marginulina* sp., *Cibicides* sp., *Bolivina* sp., *Asterigerina* sp., *Robulus* sp., *Vaginulina* sp., *Nodosaria* cf. *N. latejugata, Lagena* sp., and *Dentalina* sp.) listed from the Debris Dam sandstone (L.S.J.U. Locs. 2794 and 2795) of Upper Cretaceous age, Santa Barbara County, "suggest approximate chronologic equivalence with a part of the Panoche formation in the San Joaquin Valley", and 13 species of Foraminifera *(Asterigerina spinea, Bathysiphon alexanderi. Dorothea eocenica, Globotruncana arca, G. canaliculata, Gumbelina costulata, Gyroidina depressa, G. globosa, Haplophragmoides eggeri, H. excavata, Marssonella ellisorae, M. oxycona,* and *Trochammaina globigeriniformis)* from the newly established Pendola formation (L.S.J.U. Locs. M-484, M-485, M-537) indicate an approximate upper Senonian or Maastrichtian age for this Upper Cretaceous formation.

PAYNE, M. B.

Type Moreno formation and overlying Eocene strata on the west side of the San Joaquin Valley, Fresno and Merced counties, California: State of California, Div. Mines, Special Rept. 9, 29 p., 11 figs., 5 pls. (including geologic maps).

A tentative check list of the stratigraphic ranges of eleven important Upper Cretaceous foraminifers *(Valvulineria "panochensis", V. "pachecoensis", Siphogenerinoides whitei, S. clarki* var., *S. clarki, Bulimina prolixa, Globotruncana conica, G. arca, Marginulina jonesi, Silicosigmoilina californica*, and *Nodosaria spinifera)* in the Moreno and Panoche formations, as well as fossil registers of foraminiferal species from various stratigraphic levels within these units are given.

1952

102. AVNIMELECH, MOSHÈ

Revision of the tubular Monothalamia: Contr. Cushman Found. Foram. Res., v. 3, pt. 2, p. 60-68, 17 figs.

Assigns *Bathysiphon perampla* Cushman and Goudkoff, 1944, of the Upper Cretaceous of California to *Psammosiphonella* n. gen., and gives a Senonian (Upper Austin) age for *Bathysiphon alexanderi* Cushman, 1933, and an Aquitanian (Upper Oligocene)—Miocene range for *Bathysiphon taurinensis* Sacco, 1893 (these latter two species have been recorded by Goudkoff (1945, table 2) among others, from the Great Valley of California and elsewhere in the State.)

103. BANDY, O. L.

Foraminiferal evidence as to the age of the Pacific Coast *Coralliochama* beds: Geol. Soc. America, Bull., v. 63, no. 12, pt. 2, p. 1320-1321 (Abs).

"In 1885 White described a Middle Cretaceous rudistid *Coralliochama* from beds near Gualala, California, and from Todos Santos Day, Baja California. Subsequently this peculiar form was correlated with the Turonian (Anderson and Hanna, 1935) and with the Maestrichtian (Durham and Kirk, 1950). This last correlation was based upon the association of the ammonites *Nostoceras* and *Parapachydiscus catarinae* Anderson and Hanna with the *Coralliochama* beds.

"Recent work on the Upper Cretaceous Foraminifera of California has revealed an occurrence of *Coralliochama* in the Carlsbad area of California. The Foraminifera of these beds have been correlated with the Upper Taylor faunas of the Gulf Coast and with the Upper Senonian (Middle Campanian) faunas of Europe. A *Coralliochama* occurrence at Point Loma, San Diego County, is also associated with abundant and diagnostic Foraminifera, which here correlate with the Taylor beds of the Gulf Coast and with the Lower Campanian of Europe.

"The contradictory evidence as to the age of the *Coralliochama* beds cannot be explained by redeposition of the rudistid fauna inasmuch as it would then signify that such fauna was originally from the Lower Senonian or older strata, thereby conflicting even more with the ammonite evidence. The Foraminifera in each case range throughout the shale beds and are well preserved with no indication of redeposition. Hence, it would seem that the most logical solution is that the range of *Parapachydiscus catarinae*, the nostoceríd ammonites, and the *Coralliochama* fauna is of Campanian age."

104. CAMPBELL, A. S.

An introduction to the study of the Radiolaria: Micropaleontologist, v. 6, no. 2, p. 29-44, figs. 1-5, figs. A, B.

Various species of *Nassellina* from the Cretaceous of California are figured, thin-sections of Franciscan radiolarian chert are illustrated, and occurrences of Radiolaria in the Franciscan (Jurassic) chert and in the Cretaceous of central California are noted.

105. CHURCH, C. C.

Cretaceous Foraminifera from the Franciscan Calera limestone of California: Contr. Cushman Found. Foram. Res., v. 3, pt. 2, p. 68-70, 2 text-figs.

Specimens from the type locality of the Calera limestone (Rockaway Beach, San Mateo County) collected by Church and C. E. Sturz and sent to Hans Bolli of Trinidad are tentatively assigned a Middle to Upper Cenomanian age. Bolli stated, however, that to ascertain the age on a *Globotruncana* basis "more and better preserved specimens should be available." (Nevertheless, he based his age determination on Reichel's and Sigal's European studies of *Globotruncana* and related forms.)

In addition to *Globotruncana* (*Rotalipora*) *apenninica* Renz var. *typica* Gandolfi (Middle to Upper Cenomanian) and *Globotruncana* (*Globotruncana*) *stephani* Gandolfi var. *turbinata* Reichel (Middle to Upper Cenomanian) there are at least 10 other genera and species (including *Pseudoclavulina* sp., *Pleurostomella* sp., *Anomalina* sp., *Dentalina* sp., *Globigerina* sp., *Cibicides* sp., *Gyroidina* sp. cf. *G. depressa*, and *Schackoina cenomana*), of which the latter was described from the Cenomanian of Germany (See Kupper, 1956, for nomenclatural changes). "The fauna as a whole has a decidedly basal Upper Cretaceous aspect. Additional information afforded by this unusual fauna tends to support the conclusion that the Calera limestone is somewhere close to the Middle Cretaceous or basal Upper Cretaceous in age.

"It now seems to be the general conclusion of most workers in California that Franciscan type rocks cover a wide range in age from Upper Jurassic to Middle or even basal Upper Cretaceous. Further detailed work will be necessary to narrow the age limit of the various members of the Franciscan formation." (Küpper, 1956, assigned an Upper Cenomanian age to the Calera, and Thalmann *in* Irwin, 1957, gives a Cenomanian age for the Calera).

106. DE LAVEAGA, MIGUEL

Oil fields of Central San Joaquin Valley Province: AAPG-SEPM-SEG Guidebook—Field Trip

Routes, Oil Fields, Geology, Joint Annual Meeting, Los Angeles, p. 99-103.

The foraminifers *Bulimina prolixa* and *Siphogenerinoides whitei* are reported from gray, highly carbonaceous silty shale of Upper Cretaceous age (Moreno formation ?).

107. MAYNC, WOLF

Critical taxonomic and nomenclatural revision of the Lituolidae based upon the prototype of the Family, *Lituola nautiloidea* Lamarck, 1804: Contr. Cushman Found. Foram. Res., v. 3, pt. 2, p. 35-56, 2 text-figs. (A and B), pls. 9-12.

Does not favor allocation of *Cribrostomoides cretacea* Cushman and Goudkoff (1944) from the Upper Cretaceous of California to the genus *Barkerina* Frizzell and Schwartz, 1950 (*vide*).

108. PACIFIC SECTION AMER. ASSOC. PETROLEUM GEOLOGISTS

Cenozoic correlation section paralleling north and south margins western Ventura basin from Point Conception to Ventura and Channel islands, California (2 sheets). [No. 5].

Foraminifera are noted as being present in Cretaceous strata of San Miguel Island.

1953

109. BRIGGS, L. I., JR.

Upper Cretaceous sandstones of Diablo Range California: Univ. Calif., Publ. Geol. Sci., v. 29, no. 8, p. 417-452, 7 text-figs., pls. 32-34. (Also see: "Deposition of Upper Cretaceous sediments, Diablo Range, California" in Geol. Soc. America Bull., v. 63, no. 12, pt. 2, 1952, p. 1237 (Abs.).)

Fish scales, Foraminifera, Radiolaria, and diatoms are recorded, but not specifically identified, from the Upper Cretaceous Moreno shale.

In referring to fairly deep-water deposition of Upper Cretaceous sediments of the Diablo Range, as suggested by slump structures, the writer states: "Goudkoff (1945, pp. 1003, 1006) found that the lower beds of the Upper Cretaceous along the eastern border of the Diablo Range north of Coalinga contain a 'fairly deep and cool' water foraminifera fauna (included in Goudkoff's Delevanian, Cachenian, and Weldonian stages, approximately equivalent to the lower 25,000 feet of strata in the Ortigalita section). However, since the major part of this sequence—possibly the lowermost 15,000 feet—contains 'only a meager fauna of poorly preserved and indeterminate species of arenaceous foraminifera, here and there associated with limonitized radiolarian tests' (Goudkoff, 1945, p. 944), paleontological evidence for this part of the section must be considered extremely tenuous."

110. BRIGGS, L. I., JR.

Geology of the Ortigalita Peak quadrangle, California: State of California, Div. Mines, Bull. 167, 61 p., 4 pls., 33 figs.

Sixteen foraminiferal species—constituting an assemblage probably falling in Goudkoff's D-1 zone—are listed (by C. F. Green) from the Moreno shale in Dog Leg Creek (SW¼ sec. 12, T. 12 S., R. 10 E.). These are: *Globotruncana arca, Marginulina* cf. *modesta, Siphogenerinoides* cf. *clarki, * S. whitei, * Bulimina* cf. *triangularis, B. prolixa, Cibicides* sp., *Eponides* sp., *Globigerina cretacea, Globigerinella voluta, * Guembelina globulosa, Gyroidina* sp., *Lagena acuticosta, Nodosaria nuda, Rotalia* sp., *and * Ventilabrella ornatissima.* However, there are several forms in the above assemblage, including those marked by an asterisk, that the author states do not belong to the D-1 zone.

111. BRÖNNIMANN, PAUL, AND BROWN, N. K., JR.

Observation on some planktonic Heterohelicidae from the Upper Cretaceous of Cuba: Contr. Cushman Found. Foram. Res., v. 4, pt. 4, p. 150-156, 14 text-figs.

Gümbelina costulata Cushman from the Upper Cretaceous Pendola shale near Santa Barbara, California (Page, Marks, and Walker, 1951) and *Gümbelina striata* (Ehrenberg) recorded by Bandy (1951) from the Upper Cretaceous (Campanian) of the Carlsbad area, San Diego County, California, are placed in *Pseudogümbelina* n. ge

112. CAMPBELL, A. S.

A new radiolarian genus: Jour. Paleontology, v. 27, no. 2, p. 296.

States that "at least one species" of the new subgenus *Streptodelus* (not genus as recorded in title) occurs in the Upper Cretaceous of California.

113. EDGELL, STEWART

Some guide Foraminifera of the Upper Cretaceous and Lower Tertiary in Australia and California: Jour. Paleontology, v. 27, no. 6, p. 903 (Abs. . . . Amer. Assoc. Petroleum Geologists, Bull., v. 37, no. 12, p. 2781 (Abs.) . . . Jour. Sedimentary Petrology, v. 24, no. 2, p. 145 (Abs.).

"A number of stratigraphically restricted species of Foraminifera are found in the late Cretaceous and early Tertiary of Australia and California. These cosmopolitan species are also found in many other parts of the world, often under different names. They have been noted in samples collected here for the Richfield Oil Corporation and for the Bureau of Mineral Resources in northwest Australia. Their identification permits direct or indirect correlation with standard European stages and thus contributes to a universal stratigraphy, as well as to the knowledge of paleogeography. In addition, the widespread occurrence of index Foraminifera for the Maastrichtian and Danian-Paleocene often permits an exact distinction between uppermost Cretaceous and lowermost Tertiary."

114. HAMILTON, E. L.

Upper Cretaceous, Tertiary, and Recent planktonic Foraminifera from Mid-Pacific flat-topped

seamounts: Jour. Paleontology, v. 27, no. 2, p. 204-237, pls. 29-32, 5 text-figs.

Reference is made to reports by Glaessner (1945), Thalmann (1942, 1943), and Bandy (1951) on the occurrence of *Globotruncana* in the Upper Cretaceous of California.

15. NEUERBURG, G. J.

Geology of the Griffith Park area, Los Angeles County, California: State of California, Div. Mines, Special Rept. 33, 29 p., 1 pl., 15 figs.

Fish scales—some of which are deformed—are reported from the Cahuenga and Griffith beds of Cretaceous (?) age.

16. OGLE, B. A.

Geology of the Eel River valley area, Humboldt County, California: State of California, Div. Mines, Bull. 164, 128 p., 6 pls., 14 figs.

The foraminifers *Cribrostomoides* sp. and *Clavulina* sp. are recorded from the Upper Cretaceous ? to Lower Jurassic Yager mudstone in the Forest of Arden Resort north of Garberville, and *Bathysiphon* sp. and *Silicosigmoilina* sp. from a Yager sample whose locality is not given. The writer states that he and others "have seen *Bathysiphon* in some sheared shales mapped as part of the Franciscan, but no mention of them has been found in the literature on Knoxville and Franciscan rocks" and that he has been informed by Dr. N. L. Taliaferro that foraminifers similar to *Bathysiphon* have been found "in Knoxville shale on the Pacheco Pass road."

17. RIEDEL, W. R.

Mesozoic and late Tertiary Radiolaria of Rotti: Jour. Paleontology, v. 27, no. 6, p. 805-813, pls. 84-85, 1 text-fig.

Similarity of some radiolarians from this island (near Timor) to specimens of the genus *Spongosaturnalis* Campbell and Clark (1944) from the Upper Cretaceous of California is suspected.

18. SCHOELLHAMER, J. E., AND KINNEY, D. M.

Geology of a part of Tumey and Panoche Hills, Fresno County, California: U. S. Geol. Surv., Oil and Gas Investigations Map OM 128.

The foraminifer "*Siphogenerinoides whitei*, generally considered a Cretaceous guide fossil by California micropaleontologists, is abundant throughout the Marca shale member but has not been found above the white limy concretions whose highest occurrence marks the top of Payne's Marca." This fossil "and accompanying Foraminifera are prominently displayed on weathered surfaces of the white limestone concretions . . . [and] although [the fossil is] useful in drawing the upper boundary of the Marca shale member [it] is also present below the Marca."

9. WEAVER, C. E.

Eocene and Paleocene deposits at Martinez, California: Univ. Washington Publ. in Geol., v. 7, viii + 102 p., 17 pls.

Silty shales of Upper Cretaceous age in the Martinez area contain a few specimens of arenaceous Foraminifera. (See "Faunal Localities" for occurrences.)

1954

120. ANONYMOUS

Northern California Geol. Soc., Pacific Section A.A.P.G. Spring field trip, May 7-8, Capay Valley-Wilbur Springs, West Side Sacramento Valley, California, 15 p., 3 text-figs., 4 pls. (including geologic map and correlation chart).

Listed in the correlation chart are the characteristic Foraminifera of the various stages of the Upper Cretaceous (Goudkoff, 1945) along the west side of the Sacramento Valley (both Goudkoff's and Beck's zonal species for this area are given—also see Correlation section, northern Sacramento Valley, California, by Pacific Section Amer. Assoc. Petroleum Geologists, 1954).

Also, the abundance of Foraminifera (and ammonites) at the type locality of the Upper Cretaceous Yolo shale (T. 12 N., R. 4 W., Yolo County) is noted.

121. AYALA CASTAÑARES, AGUSTIN

El genero *Globotruncana* Cushman, 1927, y su importancia estratigrafica: Asociacion Mexicana de Geologos Petroleros, Bol., v. 6, nos. 11-12, p. 353-471, 16 pls., 1 table.

References are made to various globotruncanid species from the Upper Cretaceous of California.

122. BANDY, O. L.

Aragonite tests among Foraminifera: Jour. Sed. Petrology, v. 24, no. 1, p. 60-61.

The following foraminiferal species from the Upper Cretaceous (Campanian) of California showed a positive Meigen's reaction for aragonite: *Ceratobulimina cretacea*, *Colomia californica*, *C. californica* var. *mundula*, and *Höglundina supracretacea*.

123. CAMPBELL, A. S.

Radiolaria: *in* Treatise on Invertebrate Paleontology, part D, Protista 3, p. D11-D163, figs. 6-86.

Various species from the Upper Cretaceous of California are recorded, with both the Funks formation in northern California and the Water Canyon formation of the San Joaquin Valley being especially abundant in kinds and numbers of Radiolaria.

Reference is also made to a uniform "but very small fauna of only 10 genera and 13 species" in the Franciscan (Jurassic) chert.

124. CAMPBELL, A. S.

Tintinnina: *in* Treatise on Invertebrate Paleontology, pt. D, Protista 3, p. D166-D180, figs. 88-92.

A doubtful occurrence of tintinnids, a group of ciliated protozoans, in the Calera limestone of the Franciscan (Upper Jurassic) formation is mentioned.

125. DE KLASZ, V. I., AND KNIPSCHEER, H. C. G.
Die Foraminiferenart *Reussella szajnochae* (Grzybowski): Ihre systematische Stellung und regionalstratigraphische Verbreitung: Geol. Jb., Band 69, p. 599-610, pl. 45, 1 table.

The holotype and paratypes of *Reussella californica* Cushman and Goudkoff (1944) from the Upper Cretaceous of California are designated a subspecies of *R. szajnochae* (Grzybowski).

126. EASTON, W. H.
Ammonite from the Cretaceous near Carlsbad, California: Geol. Soc. America, Bull., v. 66, no. 12, pt. 2, p. 1647-1648 (Abs.).

Records the discovery by William G. Hannah in 1950 of "a specimen of *Parapachydiscus* [*Pachydiscus*] *peninsularis* Anderson and Hanna, 1935, in float from the same outcrops from which Bandy's (1951, 1952) foraminifers came and from which Popenoe collected smooth "*Pachydiscus*" near Carlsbad". It is also stated that "the range of *Parapachydiscus* is compatible with foraminiferal evidence that the *Coralliochama* beds may be partly of Campanian age".

127. HERTLEIN, L. G., AND GRANT, U. S. IV
Geology of the Oceanside–San Diego coastal area, southern California: *in* Geology of Southern California: State of California, Div. Mines, Bull. 170, Chapter 2, Geology of the Natural Provinces, p. 53-63, 6 figs.

The foraminifers *Gaudryina oxycona* and *Globotruncana* [= ? *Bulimina*] *obtusa* are recorded (with mollusks) from marine Cretaceous rocks.

128. NATLAND, M. L., AND ROTHWELL, W. T., JR.
Fossil Foraminifera of the Los Angeles and Ventura Regions, California *in* Geology of Southern California: State of California, Div. Mines, Bull. 170, Chapter 3, Historical Geology, p. 33-42, 7 figs.

"*Globotruncana arca* (Cushman) and *Anomalina henbesti* Plummer are characteristic (Cretaceous) forms in the Ventura basin, in the Santa Ana Mountains, and in San Diego County. They correlate with the Panoche group of the San Joaquin Valley, with the Campanian and possibly, in part, with the Maestrichtian of Europe."

Reference is also made to the Holz member of the Ladd formation, which contains Foraminifera that correlate with those of the Taylor of Texas, and to Fig. 3E which shows Upper Cretaceous foraminiferal localities in the Silverado Canyon of the Santa Ana Mountains.

129. PACIFIC SECTION AMER. ASSOC. PETROLEUM GEOLOGISTS
Correlation section northern Sacramento Valley, California (2 sheets–unnumbered). [No. 6].

The correlation chart lists the Upper Cretaceous foraminiferal stages of Goudkoff (1945) as well as the characteristic fossils (Foraminifera) of these stages (according to both Goudkoff and Beck).

The committee preparing the section writes (Note C): "Rock unit names have not been given to the Upper Cretaceous E, F, and G shales and sands in the subsurface of this area, and none are in common use except where sands in these intervals are locally gas productive. The name Forbes shale is sometimes applied to F-1 Zone shales characterized by *Marginulina curvisepta* Cushman and Goudkoff (*M. jonesi*) and *Cribrostomoides cretacea* Cushman and Goudkoff, but this committee does not recommend such usage in this area where relationship with the type locality of the Forbes is not clear. The term, "First definite Cretaceous" is used to signify the first occurrence of relatively abundant, significant microfauna. This is usually Goudkoff's E′ assemblage or Beck's *Planulina constricta* zone".

1955

130. GRAHAM, J. J., AND CLASSEN, W. J.
A Lower Eocene foraminiferal faunule from the Woodside area, San Mateo County, California: Contr. Cushman Lab. Found. Foram. Res., v. 6, pt. 1, 38 p., 1 text-fig., 6 pls.

Notes that the Cretaceous "Chico" foraminiferal assemblage of Martin (1937) from the San Francisquito Creek area northeast of Searsville Lake is assigned to the Eocene.

131. KÜPPER, KLAUS
Upper Cretaceous Foraminifera from the "Franciscan Series" New Almaden District, California: Contr. Cushman Found. Foram. Res., v. 6, pt. 3, p. 112-118, 123, pl. 18.

Nine well-preserved species–*Globotruncana* (*Rotalipora*) *globotruncanoides*, *G.* (*Rotalipora*) *apenninica apenninica*, *G.* (*Rotalipora*) *evoluta*, *G.* (*Thalmanninella*) sp., *G.* (*Rotundina*) *aumalensis*, *G.* (*Rotundina*) *stephani stephani*, *G.* (*Rotundina*) *californica*, *Planomalina buxtorfi*, and *Globigerina* sp.–from the "Franciscan Series" in the New Almaden area, Santa Clara County, L.S.J.U. Loc. M-609, are recorded, figured, and partially described. Also, nomenclatural changes are made for several of the pelagic species recorded by Cushman and Todd (1948) and by Church (1952) from the Cretaceous of the New Almaden district and the type area of the Franciscan Calera limestone respectively (also see Brönnimann and Brown, 1956).

These fossils constitute an entirely different [named] assemblage from that recorded by Cushman and Todd (1948) from the same locality (sec. 24, T. 8 S., R. 1 W., M.D.B.M., Los Gatos quadrangle), and favor correlation of the New Almaden Franciscan limestones and shales "with strata classified as Cenomanian in Europe and Africa." (Inference is made that the faunule is early or medial Cenomanian in age–also see Glaessner, 1949; Küpper, 1956; and Loeblich and Tappan, 1959).

Notes on the stratigraphic distribution of the nine species at various Cretaceous localities outside the United States are also given.

132. PETTERS, VIKTOR

Development of Upper Cretaceous foraminiferal faunas in Columbia: Jour. Paleontology, v. 29, no. 2, p. 212-225, 7 text-figs.

Marginulina curvisepta Cushman and Goudkoff (1944), *Marginulinopsis decursecostata* Thalmann (1937), *Siphogenerinoides clarki* Cushman and Campbell (1936), and *S. whitei* Church (1943) are recorded from various provinces.

1956

133. BRÖNNIMANN, PAUL, AND BROWN, N. K., JR.

Taxonomy of the Globotruncanidae: Eclogae geol. Helv., v. 48, no. 2, p. 503-561, pls. 20-24, 24 text-figs.

The foraminifers *Globotruncana (Rotundina) aumalensis* (Sigal) and *Globotruncana (Rotundina) stephani stephani* (Gandolfi) of Küpper (1955, p. 116), from the "Franciscan Series" of the New Almaden district, California are placed in the synonymy of *Praeglobotruncana delrioensis* (Plummer).

134. HARRIS, R. W., AND McNULTY, C. L., JR.

Notes concerning a Senonian valvulinerian: Jour. Paleontology, v. 30, no. 4, p. 865-868, pl. 97.

Gyroidina depressa (Alth) recorded by Cushman and Church (1929, p. 515-516, pl. 41, figs. 4-6) from the Upper Cretaceous near Coalinga, California, and *Valvulineria cretacea* (Carsey) of Bandy (1951, p. 504, pl. 74, figs. 1a-c) from the Campanian of the Carlsbad area, San Diego County, California, are placed in the synonymy of *Valvulineria lenticula* (Reuss), a foraminifer whose type is from the Senonian of Bohemia.

135. HERTLEIN, L. G.

Cretaceous ammonite of Franciscan group, Marin County, California: Amer. Assoc. Petroleum Geologists, Bull., v. 40, no. 8, p. 1985-2002, 1 pl., 7 figs.

Reference is made to Church's (1952) discussion of the Foraminifera of the type Calera limestone.

136. KÜPPER, KLAUS

Upper Cretaceous pelagic Foraminifera from the "Antelope Shale", Glenn and Colusa counties, California: Contr. Cushman Found. Foram. Res., v. 7, pt. 2, p. 40-47, pl. 8, 1 text-fig.

Four species and one subspecies—*Globotruncana (Praeglobotruncana) stephani turbinata*, *G. (Praeglobotruncana) renzi* subsp. *primitiva* n. subsp., *Globotruncana* n. sp. indet., *Schackoina* sp. cf. *S. gandolfi*, and *S. cenomana*—are described and figured from the "Antelope Shale", Lodoga Quadrangle. They indicate an Upper Cenomanian age (basal Upper Cretaceous) for this formation, are equivalent to that of the Calera limestone at its type locality (see Church, 1952).

This study was based on material from three localities (sec. 8, T. 17 N., R. 4 W., M.D.B.M., Colusa County, Loc. GGCM; sec. 20, T. 19 N., R. 4 W., M.D.B.M., Glenn County, Loc. DF3; and in sec. 2, T. 18 N., R. 5 W., M.D.B.M., Glenn County, Loc. DC 6), 1860, 2820, and 1650 stratigraphic feet respectively below the Venado sandstone.

The text-figure shows the stratigraphic distribution of the more common genera, subgenera, and species of *Schackoina* and *Globotruncana* in the interval from Aptian to Coniacian.

Also, the following nomenclatural changes are listed for foraminifers recorded by Church (1952) from the "Franciscan" Calera limestone: *Globotruncana (Rotalipora) apenninica apenninica* (Renz) for *Globotruncana (Rotalipora) apenninica* (Renz) var. *typica* Gandolfi, and *Globotruncana (Praeglobotruncana) stephani* (Gandolfi) *turbinata* (Reichel) for *Globotruncana (Globotruncana) stephani* Gandolfi var. *turbinata* Reichel. (See Thalmann, 1959.)

137. RIEDEL, W. R., AND SCHLOCKER, JULIUS

Radiolaria from the Franciscan group, Belmont, California: Micropaleontology, v. 2, no. 4, p. 357-360, 7 text-figs.

Seven poorly preserved species (*Conosphaera* sp., *Cryptocephalus* ? sp., *Dicolocapsa* sp., *Tricolocampa* sp., *Dictyomitra* sp. a, *D.* sp. b., and *D.* sp. c) are described and figured from a shale (part of the Sausalito chart) which, in 1931, was exposed east of Belmont (NE½ NE¼ sec. 11, T. 5 S., R. 4 W., San Mateo quadrangle).

Similarities of the Franciscan radiolarians with some species from the Jurassic, and with others from the Cretaceous, of other parts of the world fail, however, to distinguish whether the shale is Jurassic or Cretaceous in age.

138. SMOUT, A. H.

Three new Cretaceous genera of foraminifera related to the Ceratobuliminidae: Micropaleontology, v. 2, no. 4, p. 335-348, 2 pls., 2 text-figs.

Regards Mayne (1952) as probably being correct in rejecting *Cribrostomoides cretacea* Cushman and Goudkoff, 1944, from the Upper Cretaceous of California as a species of *Barkerina* Frizzell and Schwartz, 1950.

139. STELCK, C. R., WALL, J. H., BAHAN, W. G., AND MARTIN, L. J.

Middle Albian Foraminifera from Athabasca and Peace River drainage areas of western Canada: Research Council of Alberta, Rept. no. 75, Univ. of Alberta, Edmonton, Alberta, 60 p., 2 text-figs., 5 pls.

The Albian microfauna from the Franciscan formation of California (Glaessner, 1949) would probably be penecontemporaneous with those of the Clearwater, Grand Rapids and Joli Fou formations of the lower Athabasca drainage and from the lower part of the Fort St. John group of the upper Peace River area.

1957

140. FUKUTA, OSAMU

Upper Cretaceous Foraminifera from the Rumoi Coal Field, Hokkaido, Japan: Dept. no. 172-173, Geol. Surv. Japan, 17 p., 1 text-fig., 1 pl., 3 tables.

Records the occurrence in Campanian strata of a single fragmentary specimen of *Dentalina* cf. *stephensoni* which has similarity to *D. stephensoni* of Bandy (1951, p. 501, pl. 73, figs. 10-11) from the Upper Cretaceous (Campanian) of the Carlsbad area, San Diego County, California.

141. IRWIN, W. P.

Franciscan group in Coast Ranges and its equivalents in Sacramento Valley, California: Amer. Assoc. Petroleum Geologists, Bull., v. 41, no. 10, p. 2284-2297, 2 figs.

Besides mentioning previous references to the occurrences of Foraminifera in the Calera limestone member and similar limestones, it is stated that (1) according to Thalmann, the Calera is Cenomanian, rather than Turonian, in age, (2) foraminiferal limestones of two ages occur in the Franciscan group, (3) the Calera limestone at the quarries of Permanente Cement Company with the foraminiferal assemblage *Rotalipora-Schackoina-Globigerina-Praeglobotruncana* of the *delrioensis*-type, is clearly and undoubtedly Cenomanian in age, and (4) other bodies of limestone nearby, as well as the limestone near Laytonville, contain *Ticinella* sp., *Thalmanninella* sp., and *Globigerina* sp., of the *washitensis* group, and assemblage typical of the Upper Albian to basal Cenomanian.

142. KANAYA, TARO

Eocene diatom assemblages from the Kellogg and "Sidney" shales, Mt. Diablo area, California: Sci. Repts., Tohoku Univ., Second Ser., (Geol.) v. 28, p. 27-124, 4 text-figs., 6 tables, 5 charts.

A ?Maastrichtian age is assigned to the Marca shale member of the Moreno formation from which unit Cretaceous diatoms have been recorded by Hanna (1927, 1934) and by Long, Fuge and Smith (1946).

143. MONTANARO GALLITELLI, EUGENIA

A revision of the foraminiferal family Heterohelicidae in *Studies in Foraminifera* by A. R. Loeblich, Jr. and collaborators: U. S. Nat. Mus., Bull. 215, p. 133-154, pls. 31-34.

Type of *Gublerina* Kikoine, 1948, is listed as *Gublerina cuvillieri* Kikoine = *Ventilabrella ornatissima* Cushman and Church, 1929 (not 1930 as reported), from the Cretaceous of California.

144. NAKKADY, S. E.

Biostratigraphy and inter-regional correlation of the upper Senonian and Lower Paleocene of Egypt: Jour. Paleontology, v. 31, no. 2, p. 428-447, 3 text-figs., 1 table.

Assigns Goudkoff's Zones A2-D1 and D2-F2 of the Upper Cretaceous of California to the Upper Senonian Maastrichtian and Campanian respectively. Also shown in text-figure 3 are the stratigraphic positions of various Upper Senonian-Lower Paleocene formations in Egypt, the North European Basins, the Tethys Basin, and the Atlantic American Basins.

145. PACIFIC SECTION AMER. ASSOC. PETROLEUM GEOLOGISTS

Correlation section across central San Joaquin Valley from San Andreas fault to Sierra Nevada foot hills, California (No. 8).

The foraminifer *Siphogenerinoides whitei* Church (1943) is recorded from various subsurface sections of the Upper Cretaceous Moreno formation.

146. POZARYSKA, KRYSTYNA

Lagenidae du Crétacé supérieur de Pologne: Palaeontologia Polonica, Polska Akademia Nauk, no. 8, x + 190 p., 45 figs., 27 pls., 6 text pls.

Synonymic references to several lagenid foraminifers from the Upper Cretaceous of California are given.

147. RODDA, P. U.

Middle Cretaceous stratigraphic units in northwestern Sacramento Valley, California: Geol. Soc. America Cordilleran Sec., 53rd annual meeting, p. 34 (Abs.) . . . Geol. Soc. America Bull., v. 68, no. 12, pt. 2, 1844 (Abs.).

"Two new formations occur in a thick homoclinal section of Middle Cretaceous marine rocks in the northeast quarter of the Ono quadrangle, California. One, a 1000- to 2000-foot conglomerate-sandstone-mudstone unit, is typically developed along Crow Creek (sec. 25, T. 30 N., R. 7 W.; sec. 31, T. 30 N., R. 6 W.). It is conformable with the underlying mudstones that make up the Ono Formation (Murphy, 1956). The overlying 3900-foot formation, a thick mudstone unit with nodular limestones and a prominent sandstone in the upper part, has its type area farther down Crow Creek (secs. 31, 32, 33, T. 30 N., R. 6 W.) directly west of Gas Point. It is unconformably overlain by the Late Cenozoic nonmarine Tehama and Red Bluff formations. Several foraminiferal zones, probably ranging from late Albian to Turonian in age, are within this section. The *Pervinquieria hulenana* zone (Murphy, 1956) of the underlying Ono formation ranges up into the lower part of the conglomerate-sandstone-mudstone unit."

148. SHEPARD, F. P., LANKFORD, R. R., MILOW E. D. (Chairmen)

Syllabus Annual S.E.P.M. Field Trip, La Jolla Area, 6 p., 4 charts.

One hundred and sixteen foraminiferal species from the Upper Cretaceous of the La Jolla and San Diego Basins, western San Diego County are listed (but not stratigraphically allocated). The columnar section shows the stratigraphic ranges of *Bolivinoides miliaris* and *B. delicatula* to

be restricted to the upper part of the "Chico formation" (mostly of Upper Campanian age) and those of *Numismalis leptodisca* and *N. nummismalis* to lithologic unit *b* of the "Chico formation".

1958

149. ANDERSON, F. M.

Upper Cretaceous of the Pacific Coast: Geol. Soc. America, Mem. 71, 378 p., 75 pls., 3 figs., 8 tables.

Mentions a large Cretaceous flora (diatoms) and a rich fauna of Foraminifera, radiolarians, and other micro-organisms in the upper shales of the type Moreno formation, the occurrence of numerous species of Foraminifera in the Moreno at a well depth of 3400 feet at C.A.S. Locality 28399 in sec. 15, T. 2 S., R. 5 E., (north of Tracy) and in the lower 600 feet of the formation as exposed at the mouth of Hospital Creek, and an association of many types of Foraminifera and other micro-organisms (with a few molluscan species, including the holotype of *Baculites subcircularis* Anderson) in a thin-bedded organic shale at C.A.S. Locality 28442, near the mouth of Briones Creek in the vicinity of the John Marsh House, east of Mt. Diablo.

150. BRUCE, D. D.

Compton Landing Gas Field: Calif. Div. Oil and Gas, Summary of Operations, v. 44, no. 2, p. 59-62, 1 pl.

"The upper 1,500 feet of the Chico formation consists of shales and gas-bearing sands of the Wild Goose Series, which has been assigned to the Upper Cretaceous based on the presence of seed pods and foraminifera with probable Cretaceous affinities."

151. HILL, M. L., CARLSON, S. A., AND DIBBLEE, T. W., JR.

Stratigraphy of Cuyama Valley-Caliente Range Area, California: Amer. Assoc. Petroleum Geologists, Bull., v. 42, no. 12, p. 2973-3000, 11 figs.

A portion of the subsurface section is assigned to the Upper Cretaceous ("equivalent to a part of the Moreno formation (Upper Cretaceous) of the San Joaquin Valley") on the basis of the occurrence of the foraminifer *Siphogenerinoides whitei* in a few wells.

152. LOEBLICH, A. R., JR.

Danian stage of Paleocene in California: American Assoc. Petroleum Geologists, Bull., v. 42, no. 9, p. 2260-2261.

Foraminiferal samples from the Jergins Oil Company's Cheney Ranch well No. 1 in Sec. 29, T. 14 S., R. 13 E., the "type section" for Goudkoff's Cheneyan Stage (see his 1945 reference) contain a well-defined planktonic assemblage characteristic of the type Danian stage herein designated as earliest Tertiary (Paleocene) in age. The author recommends the dropping of the "stage term Cheneyan in California stratigraphy in favor of Danian, a term of long standing and in world-wide use."

153. MARIANOS, A. W., AND ZINGULA, R. P.

Cretaceous Foraminifera from Dry Creek, Tehama County, California: Amer. Assoc. Petroleum Geologists, 43rd Annual Meeting, 32nd Annual Meeting, Soc. Econ., Paleontologists and Mineralogists, p. 56.

"Significant foraminiferal faunas ranging in age from at least Barremian to Turonian have been recovered from approximately 29,000 feet of Mesozoic sediments exposed along Dry Creek, Tehama County, California. Abundant planktonic forms in the upper one third of the section permit correlation with European stages. Absence of these in the remainder of the sequence necessitates only generalized correlations.

"The ranges of planktonic and diagnostic benthonic forms are noted, and correlation with the Standard European section is made. The most notable planktonic species are *Globotruncana helvetica, G. sigali, Praeglobotruncana delrioensis, P. renzi, P. Stephani, Rotalipora appenninica,* and *R. roberti.*"

154. PACIFIC SECTION AMER. ASSOC. PETROLEUM GEOLOGISTS

Correlation sections—Central San Joaquin Valley from Rio Vista through Riverdale, California (10 North).

The following Goudkoff (1945) stages and Beck zones (see Correlation section northern Sacramento Valley, California, by Pacific Section Amer. Assoc. Petroleum Geologists, 1954) are recorded from various subsurface sections of the Upper Cretaceous: Stages A through C (undifferentiated), the Ingramian D-1 Stage or the *Siphogenerinoides clarki* zone, the Ingramian D-2 stage or the *Bolivina incrassata* zone, the Tracian (E) stage or the *Planulina constricta* zone, and the F (or F-1) stage or the *Marginulina jonesi* zone.

155. TRUJILLO, E. F.

Upper Cretaceous Foraminifera from near Redding, Shasta County, California: S.E.P.M., Pacific Coast Section, Annual Convention, November 6, p. 30. (Abs.).

"Three Late Cretaceous shale units cropping out in the northern Great Valley have been sampled for foraminiferal content. Approximately 2500 feet of section is represented in association with 1500 feet of unsampled sandstone. Ninety species of Foraminifera—twenty-two of which are new—are illustrated, described and their stratigraphic ranges determined. Two distinctive faunas are recognizable, the division coinciding approximately with the Turonian-Senonian boundary. Arenaceous species constitute the greater number of individuals; while for stratigraphic purposes the Orbulinidae—especially the genus *Globotruncana* — are dominant in the Turonian and they, with the Rotaliidae, are of greatest importance in the Senonian. Most of the species have been previously reported from the European and Gulf Coastal regions. An interpretation of the

paleoecology indicates a sublittoral zone as the site of deposition for associated sediments. On the basis of foraminifers and diagnostic megafossils, the ages of the units are determined as Middle Turonian, Coniacian and Santonian."

1959

156. ALMGREN, A. A.

The stratigraphic position of *Reussella szajnochae* var. *californica* in the Sacramento Valley, California: Thirty-sixth Ann. Meeting, Program Pacific Sections AAPG, SEG, SEPM, in conjunction with National SEG, p. 35 (Abs.).

"A study of the distribution of *Reussella szajnochae* var. *californica* in the Sacramento Valley, California, reveals that this species is not restricted to the G-1 zone of Paul P. Goudkoff [1945] as was indicated in his paper on the 'Stratigraphical Relations of the Upper Cretaceous in the Great Valley, California.' To the writer's knowledge this species does not occur in the G-1 zone at all. It seems to be restricted to sediments no older than the upper part of Goudkoff's F-1 zone and no younger than basal E zone.

"Many of the Foraminifera associated with this species are characteristic of the basal F-2 and G-1 zones of Goudkoff. These are considered to be 'recurrent,' due to ecologic conditions similar to those which prevailed during the deposition of the sediments of basal F-2 and G-1 zones. A few of the associated species seem to be restricted in occurrence to the interval in which *Reussella szajnochae* var. *californica* is present, clearly distinguishing this interval from the basal F-2 and G-1 zones below. Based on the range of *Reussella szajnochae* of phylogenetic development similar to *R. szajnochae* var. *californica* and on certain other associated foraminifera of world-wide significance, *Reussella szajnochae* var. *californica* appears to be restricted to rocks of Campanian age (probably upper) in the Sacramento Valley, California."

157. BURMA, B. H.

On the status of *Theocampe* Haeckel, and certain similar genera: Micropaleontology, v. 5, no. 3, p. 325-330.

Four species of Radiolaria *(Tricolocampe (Tricolocampium) minuta, T. (Tricolocamptra) attamontensis, Theocampe (Theocampana) vanderhoofi,* and *T. (Theocamptra) latipunctata)* from the lower Maastrichtian of Middle California (Campbell and Clark, 1944) are referred to the genus *Theocampe* Haeckel, 1887, emend. Burma.

158. GRAHAM, J. J., AND CHURCH, C. C.

Upper Cretaceous Foraminifera from Stanford University Campus, California: Geol. Soc. America Program Ann. Meetings, Nov. 2-4, p. 52A-53A . . . Bull. Geol. Soc. America, v. 70, no. 12, pt. 2, p. 1610-1611, (Abs.) . . . Thirty-sixth Ann. Meeting, Program Pacific Sections, AAPG, SEG, SEPM, in conjunction with national SEG, p. 35-36 (Abs.)—with the following changes: Substitute Taylor-Navarro *for* Taylor in first paragraph and *Loxostomum eleyi* for *Bolivinitella eleyi*, and *Bolivinoides decoratus latticeus* for *Bolivinoides delicatula* in third paragraph.

"An Upper Cretaceous siltstone along the east bank of San Francisquito Creek beneath Willow Road Bridge, on Stanford University Campus, Santa Clara County, has yielded a large and diversified foraminiferal assemblage that appears to be of Campanian age. This faunule is correlative—among others in California—with several from the upper part of the Panoche Group (Uhalde shale) of Fresno County, and some from the Tracian and Weldonian stages. It is also correlative with faunas from Taylor strata of the Gulf Coast and probably with assemblages from the Upper Senonian of northwestern Europe.

"The 120 species, some not previously reported from California, consist mainly of calcareous perforate and arenaceous forms. The calcareous species outnumber the arenaceous ones, but the arenaceous foraminifers have more individuals. Both bottom-dwelling and open-sea genera are present with the benthonic group more abundant. Dominant arenaceous species are *Haplophragmoides* sp., *Marssonella trochus*, *Plectina watersi*, and *Silicosigmoilina californica.* Coiled and rectilinear lagenids form the principal constituents among the calcareous species, with rotaliids next in abundance; anomalinids, buliminids, ellipsobuliminids, globotruncanids, polymorphinids, and other are less common or rare. Important stratigraphic markers include *Bolivina incrassata*, *Bolivinitella eleyi*, *Bolivinoides delicatula*, *Globotruncana arca*, *G. elevata stuartiformis*, *G. fornicata*, *Neoflabellina numismalis*, and *Reussella szajnochae californica.* Associated with the foraminifers are some Campanian cephalopods *(Cymatoceras suciense* and *Baculites inornatus).*

"Comparison of the Stanford faunule with analogous Recent foraminiferal genera suggests that the Cretaceous siltstone is a neritic deposit laid down in temperate waters."

159. HALL, C. A. JR., JONES, D. L., AND BROOKS, S. A.

Pigeon Point formation of Late Cretaceous age, San Mateo County, California: Amer. Assoc. Petroleum Geologists, Bull., v. 43, no. 12, p. 2855-2859, 2 figs. (including geologic map).

Eight species of Foraminifera *(*Bathysiphon taurinensis, *Gaudryina rudita* var. *diversa, Haplophragmoides eggeri, *Marginulina curvisepta, *Marssonella oxycona, Silicosigmolina californica, Eponides* sp. and *Nodosaria* sp.) are recorded "from an isolated outcrop of the Pigeon Point formation in fault contact with the Pliocene Purisima formation." The starred microfossils are designated as being of Campanian age.

160. LOEBLICH, A. R. JR.

California lower Midwayan Foraminifera: Thirty-sixth Ann. Meeting, Program, Pacific Sections

AAPG, SEG, SEPM, in conjunction with National SEG, p. 34 (Abs.).

"The earliest Tertiary in California is represented by the "Cheneyan" stage of Goudkoff [see his 1945 reference] instead of the Ynezian stage of Mallory. The Cheneyan is represented on the surface by Max B. Payne's Dos Palos member of the Moreno formation. Recent continuous coring of the type Dos Palos and upper Marca members of the Moreno formation has produced detailed stratigraphic and paleontologic data definitively correlating the subsurface and surface sections, resulting in relocation of the Cretaceous-Tertiary boundary. Foraminiferal faunas from the subsurface Cheneyan and surface Dos Palos member of the Moreno formation are those of the *compressa-daubjergensis* planktonic foraminiferal zone. It thus may be correlated with the entire surface Midway group of Texas, the lower Midwayan Clayton formation of Alabama, subsurface strata in North Carolina, the Brightseat formation of Maryland, lower Hornerstown marl of New Jersey, the lower Velasco of Mexico, the lower Lizard Springs of Trinidad, the Danian of Biarritz of southwestern France, the type Montian (Tuffeau de Cipley) of Belgium, the type Danian (Danskelkalk) of Denmark and the Teurian stage of New Zealand.

"Based on accurately determined planktonic Foraminifera Californian Paleocene-Eocene strata can be correlated in detail with European, Carribbean, Gulf and Atlantic Coast, and New Zealand strata.

"If American stage names are to be used in California it would seem preferable to adopt the well-known and widely used Gulf and Atlantic Coast stages rather than local stage names; hence Cheneyan should be replaced by Midwayan."

51. LOEBLICH, A. R., JR., AND TAPPAN, HELEN

Cenomanian planktonic Foraminifera: Thirty-sixth Annual Meeting, Program, Pacific Sections, AAPG, SEG, SEPM, in conjunction with National SEG, p. 34 (Abs.)

"Twenty-five species of planktonic Foraminifera are described and illustrated from outcropping strata of Cenomanian age in California, Kansas, and Texas, subsurface formations of the eastern and western Gulf area, a submarine core from the Blake Plateau and outcrops in Germany and Switzerland. Relative ages of these sequences and those of Trinidad, Cuba, and North Africa are also discussed.

"Two species are described as new, others are reallocated generically and synonymy is shown for certain previously described nominal species. A few of the species are restricted to the Tethyan geographical province, but many have worldwide occurrence in the Cenomanian.

"The evidence of the planktonic Foraminifera suggests that both the Britton and Arcadia Park members of the Eagle Ford shale of north Texas are Cenomanian rather than Turonian in age. The subsurface lower Atkinson formation of Florida, Alabama and Georgia is believed to be wholly equivalent to the Eagle Ford, rather than to the Woodbine, and is also equivalent to the Hartland member of the Greenhorn limestone of Kansas. The 'Franciscan' series of the New Almaden district of California is regarded as of mid to upper Cenomanian age, rather than upper Albian or lower Cenomanian as previously considered. The submarine core of the Blake Plateau contains both lower and middle Cenomanian species in its 175 cm. and is thus the oldest known material found in a submarine core."

162. PACIFIC SECTION AMER. ASSOC. PETROLEUM GEOLOGISTS

Correlation section—West Side San Joaquin Valley from Coalinga to Midway-Sunset and across San Andreas Fault to southeast Cuyama Valley, California (No. 11).

The "A?, C, and F-1? stages" of Goudkoff (1945) are recorded from various subsurface sections of the Upper Cretaceous.

163. THALMANN, H. E.

New names for foraminiferal homonyms IV: Contr. Cushman Found. Foram. Res., v. 10, pt. 4, p. 130-131.

Globotruncana küpperi Thalmann nom. nov. is proposed for *Globotruncana (Praeglobotruncana) renzi* Gandolfi and Thalmann subsp. *primitiva* Küpper, 1956, from the Upper Cenomanian "Antelope Shale" of California.

164. TOURING, R. M.

Stratigraphy of La Honda and San Gregorio quadrangles: Amer. Assoc. Petroleum Geologists, Bull., v. 43, no. 1, p. 257 (Abs.).

Upper Cretaceous foraminiferal mudstones are included in the oldest exposed rocks.

1960

165. DAILEY, D. H.

Stratigraphic paleontology of the Jalama Formation, Western Santa Ynez Mountains, Santa Barbara County, California: Thirty-seventh Ann. Meeting, Program, Pacific Sections, AAPG, SEG, SEPM, p. 23-24 (Abs.).

"The Jalama formation of late Cretaceous age is exposed along both sides of the Pacifico fault in Jalama and Santa Anita Canyons in the Western Santa Ynez Mountains. It consists of 2275 ± feet of alternating sandstones and silty shales that have been divided into seven members. The base is nowhere exposed but the geologically older Espada formation in Salsipuedes Canyon is Late Jurassic in age, which suggests an unconformity at the Espada-Jalama contact. The relationship between the Jalama and overlying Anita formations is uncertain at the type locality but an unconformity exists beyond this area.

"Approximately one hundred thirty-five species of Foraminifera, of which the majority are calcareous perforate forms, have been identified from

nineteen localities. Three separate foraminifer faunules of characteristic composition can be distinguished. Forty-four localities have yielded fifty-eight molluscan species that have been treated systematically; twelve pelecypod species and five gastropod species are new. The megafauna cannot be broken down into stratigraphic faunules but may be subdivided into two ecologic groups.

"Both the foraminifer and molluscan assemblages indicate a late Campanian age for the Jalama formation. The foraminifera correlate with Goudkoff's Tracian and upper Weldonian Stages and with the lower Navarro of the Gulf Coast.

"The megafauna is most closely related to the molluscan assemblage of the upper Chico formation, but is slightly younger, and is very close in age to the Cretaceous sediments in Bee Canyon, Orange County, California, in the Sucia Islands, Washington, and in the lower horizon in the Simi Hills, Ventura County, California."

166. FURRER, M. A.

California Cretaceous "*Siphogenerinoides*": Thirty-seventh Ann. Meeting, Program, Pacific Sections AAPG, SEG, SEPM, p. 23 (Abs.).

"Recorded occurrences of California Cretaceous *Siphogenerinoides* are restudied on the basis of topotype collections and comparisons are made with those from the Gulf Coast Texas Cretaceous sediments. Based on comparisons with the type species of *Siphogenerinoides*, *S. plummeri* (Cushman) it is suggested that California Cretaceous "*Siphogenerinoides*" be allocated to other categories."

167. GRAHAM, J. J., AND CLARK, D. K.

Lacosteina paynei, a new species from the Upper Cretaceous of California: Contr. Cushman Found. Foram. Res., v. 11, pt. 4, p. 115-116, 1 fig., pl. 16 (figs. 1-5a-d).

A new foraminiferal species—*Lacosteina paynei*—is described and figured from the Uhalde formation (holotype) and the Dosados member (paratypes) of the Moreno formation (both of Maastrichtian age) in the NW ¼ sec. 3, T.14S., R.11E., M.D.B. and M., Panoche Valley quadrangle (L.S.J.U. Locality no. M-625). The species is significant in that it extends the geographic range of the genus from isolated occurences in Morrocco, the Sinai Peninsula, the Kyzyl region in the U.S.S.R., and northern Alaska to California. Moreover, it is found in strata that may be of the same age or younger than those at the type locality (Morocco) of the genotype *Lacosteina gouskovi* Marie.

Associated with specimens of this distinctive species are several other taxa of Foraminifera, some of which are diagnostic of Goudkoff's "D-1 zone" of the California Cretaceous (Goudkoff, 1945, p. 968): *Bolivina incrassata* Reuss, *Bulimina petroleana* Cushman and Hedberg, *B. prolixa* Cushman and Parker, *B. tribedra* Cushman, *Gaveli-nella* sp. (= *Valvulineria cretacea* (Carsey) of California workers), "*Globigerinella*" *aspe* (Ehrenberg), *Globotruncana arca* (Cushman *Heterohelix globulosa* (Ehrenberg), *Psuedoguer belina excolata* (Cushman), *Rugoglobigerina r gosa* (Plummer), *Siphogenerinoides clarki* va *costifera* Cushman and Goudkoff, and *S. whit* Church.

168. MARSH, O. T.

Geology of the Orchard Peak area, Californi State of California, Div. Mines, Special Rept. 6 42 p., 2 pls., 14 figs., 11 photos.

A probable Late Cretaceous age is suggest for the Upper Jurassic (?) Hex formation on t basis of the general appearance of its bentonit clay microfauna *(Globorotalia* cf. *G. michelinia Cyclammina* ? sp. *Haplophragmoides* sp. *Bu mina* ? sp., *Nassellina* sp., and *Cytherella* cf. *bullata)* and by the comparative development two of these fossils (the foraminifer *Globorata* and the ostracod *Cytherella)*. Concerning anoth assemblage from the Hex formation at Standa Oil Co. Locs. 5194 and 5195 *(Glomospira* cf. *gordialis, Bathysiphon* sp., *Cribrostomoides* ? s *Marssonella oxycona* ?, and *Haplophragmoid* sp.) J. D. Bainton of the Standard Oil Compa states: "The above samples contain only arenac ous foraminifera. *Glomospira gordialis* . . . rang from the Austin chalk through the upper part the Taylor marl in the Gulf Coastal region. relation to Goudkoff's (1945, pp. 956-1008) stag and zones, *Glomospira gordialis* would have range from the Upper Cachenian (G-1 zon through the Upper Weldonian (F-1 and F zones). This would place these samples in t Panoche formation and possibly equivalent to t Joaquin Ridge sandstone or the Alcalde shale. T faunas . . . are not definitely definitive of a and therefore the age assignments . . . shou not be considered conclusive."

The Lower Cretaceous? Badger shale, sou and northwest of Orchard Peak, contains so arenaceous (unidentified) foraminifers, the U per Cretaceous? Risco formation yielded c specimen of *Gyroidina* sp., and very rare in terminable arenaceous Foraminifera, limoni plant remains, and limonitic diatoms? (if the toms are actually such, this is the lowest str graphic occurrence so far reported in Californi and the Upper Cretaceous Johnson Peak for tion produced several indeterminable arenace foraminifers.

The middle portion of the siltstone facies of t type locality of the Upper Cretaceous Moonli formation in the Devil's Den area yielded at Sta ard Oil Company Locs. 5213 and 5214 the foll ing arenaceous shallow water species: *Ammo cus* sp., *Bathysiphon perampla, Bathysiphon Cribrostomoides cretacea* (?), *Cyclammina Gaudryina* (?) sp., *Marssonella* sp., *Silicos moilina californica, Spiroplectammina* sp., *T chammina* cf. *T. globigerinaformis*, and *Trocha mina* (?) sp.—an assemblage of approximately u per Senonian age that "may *possibly* repres

lower *Pachydiscus* silt or *possibly* upper Joaquin Ridge time". A sample from the shale facies at Standard Oil Co. Loc. 5202 contained the arenaceous species *Bathysiphon* sp., *Cribrostomoides* (?) sp., *Gaudryina* sp., and *Silicosigmoilina californica*, an assemblage interpreted as "Upper Cretaceous Tracian ? and/or older? of Goudkoff . . . thought to be equivalent to the lower Ragged Valley shale *(Pachydiscus* silt) or older."

The upper third of the Upper Cretaceous Red Man sandstone, stratigraphically above the Moonlight formation, has numerous well preserved calcareous foraminifera indicative of a neritic environment *(Bulimina aspera, Bulimina* aff. *B. prolixa, Bulimina* sp., *Dentalina basiplanata, Dentalina* cf. *D. catenula, Dentalina* cf. *D. consobrina, Dentalina* aff. *D. legumen, Dorothia* sp., *Frondicularia* cf. *F. cordata, Frondicularia inversa, Marginulina* sp., *?Neoflabellina* cf. *N. interpunctata, Neoflabellina* or *Frondicularia* sp., *Pseudoglandulina* sp., and *Robulus* sp. Dr. Steward Edgell, who made the above identifications gives the following analysis of the assemblage: "*Frondicularia cordata* = upper Austin and Taylor; *F. inversa* = from upper Austin to Navarro; *Bulimina aspera* = mostly upper Taylor. On this rather inadequate basis a correlation is suggested with the Taylor of the Gulf Coast which is known to be equivalent to the Lower Maestrichtian and Campanian of Europe."

Concretions in the Red Man sandstone northeast of Antelope Pumping Station also contained Foraminifera, including *Dentalina* sp., and *Planularia* sp.

The highest Upper Cretaceous beds in the region—the Moreno formation—yielded an assemblage of arenaceous species *(Bathysiphon* sp., *Cribrostomoides cretacea* (?), *Dorothia* sp., *Haplophragmoides* sp., and *Silicosigmoilina californica*, which J. D. Bainton of the Standard Oil Co. of California interprets: "Based on the fauna and the lithology it is thought that this sample represents the Moreno shale. It is suggested that this sample is no younger than Upper Ciervian and no older than Upper Ingramian (Goudkoff's stages)."

9. MATSUMOTO, TATSURO

Upper Cretaceous ammonites of California—Pt. 3: Mem. Faculty Sci., Kyushu Univ., ser. D, Geol., Special v. 2, 204 p., 20 text-figs., 2 pls.

The foraminifer *Siphogenerinoides whitei* is recorded as a diagnostic fossil of the Marca shale member (Maastrichtian) of the Moreno formation, and the Dos Palos shale member of the Moreno, described by Payne (1941, p. 1953), is "referred to the Paleocene or so-called Danian" (see Goudkoff, 1945, p. 971; Payne, 1951, figs. 2, 4; Payne, 1960, fig. 5) on the basis of its foraminiferal content.

0. McGUGAN, ALAN

Upper Cretaceous Foraminifera from Vancouver Island, British Columbia, Canada: Program, Geol. Soc. America Cordilleran Section; Seismol. Soc. America; Paleo. Soc. Pacific Coast Sec., p. 52 (Abs.).

A fauna of Late Campanian age from the Cedar District, Northumberland, Upper Trent River, and low Upper Lambert formations with *Anomalina henbesti* and 18 other genera [species?] is a correlative of assemblages of Taylor and early Navarro age in California; and another of early Maastrichtian age from the uppermost part of the Lambert formation *Bolivina incrassata, Bulimina* cf. *petroleana*, spinose *Globorotalites, Allomorphina*, and *Globigerinella* is considered to correspond to Goudkoff's D-1 and D-2 zones in the Navarro of California.

171. OLSSON, R. K.

Foraminifera of the latest Cretaceous and earliest Tertiary age in the New Jersey Coastal Plain: Jour. Paleontology, v. 34, no. 1, p. 1-58, 12 pls., 2 text-figs.

Among the species cited from strata of Maastrichtian age are several from the Upper Cretaceous of California, including *Colomia californica mundula* Bandy (1951, p. 512, pl. 75, figs. 12a, b), whose type is from the Campanian of the Carlsbad area, San Diego County.

172. PACIFIC SECTION AMER. ASSOC. PETROLEUM GEOLOGISTS

Correlation Section—Sacramento Valley—North-South from Red Bluff to Rio Vista, California (No. 13).

The D to H zones of Goudkoff (1945) are represented in various subsurface sections of the Upper Cretaceous (the "Dobbins Shale", also known as the "G-shale", contains radiolarian floods and foraminiferal faunas equivalent in age to Goudkoff's G-1 zone, the "Sacramento Shale" often contains radiolarian floods and has foraminiferal faunas equivalent in age to the E and F′-1 zones, the "Winters Sands and Shales" range in age from D-2 to E, and the "Starkey Sands" are typically equivalent to Goudkoff's D-1 zone, with a fauna of D-2 age occasionally being noted in the lower portion and a C zone fauna being encountered in shales equivalent to the upper portion).

173. PAYNE, M. B.

In Pacific section S.E.P.M. Guidebook, 1960 Spring field trip, Type Panoche area, Fresno County, California, 12 p., 6 figs.

Figure 6 shows the "zones [Goudkoff's] and ranges used for guide Foraminifera" for the Upper Cretaceous—Paleocene Moreno shale and a portion of the Upper Cretaceous Panoche group. The following species are therein listed:

Valvulineria lillisi (zones A + B, of Danian or Paleocene age), *Siphogenerinoides whitei* (zone C of Maastrichtian age), *Valvulineria orolomaensis* (zones C and D of Maastrichtian age), *Bulimina prolixa* (zones C + D of Maastrichtian age), *Globotruncana arca* (zone D of Maastrichtian age and the upper portion of zone E of Campanian

age), *Siphogenerinoides clarki* (zone D of Maastrichtian age), *Bolivina incrassata* and *Nodosaria spinifera*, the latter two from the lower part of zone D (Maastrichtian) to the upper part of zone E (Campanian), *Marginulina curvisepta* (zone F of Campanian age), *Globotruncana lapparenti* (zones G_1 and G_2 of Santonian and Coniacian age respectively), *Gyroidina florealis* (lower half of zone F to G_2, from Campanian to Coniacian in age), and *Stensöina excolata* (lower half of zone F to base of G_1, of Campanian to Santonian age).

Attention is also called to the abundance of *Siphogenerinoides whitei* of Goudkoff's C "zone" in the Marca shale portion of the Moreno and to the presence of the E "zone" foraminifers "*Planulina constricta*" [or] "*Anomalina henbesti*" in the Uhalde formation of the Panoche group.

(Issued at the dinner meeting in Fresno was a chart (Table 5) compiled from data submitted to Max B. Payne by Lewis Martin in which are shown line-drawings of and the "stratigraphic distribution of some diagnostic and common Foraminifera [30 species and subspecies] from Moreno Gulch and Laguna Seca Creek, west side of San Joaquin Valley, California." Five of the fossils therein listed *(Globorotalia pseudobulloides, Globigerina triloculinoides, Globigerinoides daubjergensis, Valvulineria lillisi,* and *Spiroplectammina gryzbowski)* are restricted to the Lower Dos Palos (Danian) portion of the Moreno formation, four species *(Bulimina prolixa, Siphogenerinoides whitei, Gavelinella turbinata,* and *G. orolomaensis)* range from the Dosados sandstone and shale to the top of the Marca shale within the Moreno formation and are of Maastrichtian age, one species *(Siphogenerinoides clarki)* is restricted to the Maastrichtian part of the Uhalde formation, two species *(Globotruncana arca* and *Rugoglobigerina rugosa)* have a discontinuous range from the Upper Marlife formation (Santonian portion) to the Upper Uhalde (Maastrichtian), three species *(Bulimina spinata, Bolivina incrassata,* and *Nodosaria spinifera)* transgress the Campanian-Maastrichtian boundary in the upper part of the Uhalde, four species and subspecies *(Rzehakina epigona lata, Cribrostomoides cretacea, Gyroidina quadrata,* and *Globotruncana churchi)* range from the Upper Marlife (Santonian portion) into the Campanian part of the Uhalde, one species *(Haplophragmoides impensus)* has a discontinuous range from the Lower Marlife (Coniacian-Santonian) into the Campanian portion of the Uhalde, one subspecies *(Globotruncana lapparenti lapparenti)* ranges from the Lower Marlife (Coniacian-Santonian) into the Upper Marlife (Santonian portion), one species *(Bermudeziana uvigerinaeformis)* ranges from the upper part of the Lower Marlife into the upper Marlife and is of Santonian age, three species *(Reussella szajnoche, Stensöina excolata,* and *Gyroidina florealis)* are restricted to the Upper Marlife (Santonian), one species *(Kyphopyxa christeneri)* occurs in both the Coniacian and Santonian stages of the Marlife formation, and four species *(Planulina umbonata, Globorotalit subconicus, Stensöina exsculpta,* and *Anomali becki)* are restricted to the Lower Marlife (C niacian). Some of Martin's foraminifers are ne species or carry new names).

174. POPENOE, W. T., IMLAY, R. W., AND MURPHY, M. A.

Correlation of the Cretaceous formations of t Pacific Coast (United States and northweste Mexico): Geol. Soc. America, Bull., v. 71, no. 1 p. 1491-1540, 5 figs., 1 pl.

"The foraminiferal zones established by Gou koff (1945) for the Cretaceous beds in Californ largely on the basis of subsurface data, were co related by him with various formations on t west side of the San Joaquin Valley and along t margin of the Sacramento Valley. His H zone correlated with formations that have furnish Cenomanian or early Turonian ammonites or th are assigned to those stages because they under beds of middle to late Turonian age. For examp the H zone probably includes the "lower W tham" shale of Waltham Canyon from which t Cenomanian ammonite *Forbesiceras* has been o tained (LSJU Coll.).

"His G-2 zone is correlated with beds that co tain ammonites of middle to late Turonian a such as Members II, III, and the lower part Member IV in the Redding district, and the Sit formation and most of the Yolo formation on t west side of the Sacramento Valley. The comm ammonites in these beds are *Subprionocycl Collignoniceras, Romaniceras,* and *Otoscaphit* The top of the G-2 zone coincides with the t of the *Glycymeris pacificus* zone of Popen (1952, p. 181).

"Goudkoff's G-1 zone was correlated on t basis of microfossils with the upper part of Me ber IV and all of Member V in the Redding ar and with the Funks formation on the west side of the Sacramento Valley. Member IV in t Redding area has furnished the Coniacian ammo ites *Peroniceras* and *Prionocycloceras.* Membe IV and V both contain *Baculites schencki* Mats moto (1959a, p. 113-118), which occurs els where in the basal 700 feet of the Cretaceous se tion on Chico Creek and in the Funks formatio From Member V Matsumoto (1960, p. 10-12) r cords such species as *Baculites capensis* Woo *Inoceramus naumanni* Yokoyama, and *I.* cf. *cordiformis* Sowerby of late Coniacin to Sa tonian age. On the basis of these mollusks Gou koff's G-1 zone is correlated with the Coniaci and at least part of the Santonian stages.

"Goudkoff's F-2 zone was identified by him the Guinda formation and in small adjoining pa of the Funks and Forbes formations. The Guin formation has not yet furnished mollusks that a useful in correlation with European stages, b on the basis of stratigraphic position it should of late Santonian and early Campanian age. Pro able equivalents of the F-2 zone on Chico Cre

as indicated by microfossils, include beds containing *Submortoniceras* and *Turritella chicoensis* Gabb and some underlying beds containing *Baculites capensis* Woods (identified by Matsumoto). This baculite in Europe occurs in the upper Coniacian and the Santonian. (See Annotation 45.) Goudkoff (1945, p. 991, figs. 62, 72) shows that the F-2 zone in the subsurface pinches out rapidly eastward and becomes sandier westward.

"The presence of *Submortoniceras* in the *Turritella chicoensis* zone on Chico Creek shows that the top of that zone is not younger than Campanian and probably not younger than middle Campanian. A Campanian age is confirmed by the presence of *Canadoceras* cf. *C. multisulcatus* (Whiteaves) in the Santa Ana Mountains about 200 feet below the top of the Ladd formation (CIT loc. 1053) in the upper part of the *Turritella chicoensis* zone (Popenoe, 1942, p. 177-179).

"Goudkoff's F-1 zone was identified by him in the Forbes formation along the west side of the Sacramento Valley and in the "Joaquin Ridge" sandstone member of the Panoche formation along the west side of the San Joaquin Valley. It has since been identified in many places in California in beds characterized by *Metaplacenticeras*. This ammonite in California and Japan occurs near the top of a thick sequence of Campanian age.

"Goudkoff's E zone according to him does not outcrop in the Sacramento Valley but is present in the subsurface. He identifies it on the outcrop in the San Joaquin Valley in the lower part of the Ragged Valley shale member of the Panoche formation. His next higher D-2 zone is identified in the upper part of the Ragged Valley shale member which has furnished an ammonite faunule consisting of *Pachydiscus octadensis* (Stoliczka), *P. catarinae* (Anderson and Hanna), and *Baculites rex Anderson*. This faunule is considered to be of early Maestrichtian age for reasons discussed under the heading Correlations with European Stages.

"Goudkoff's D-1, C, and B zones may likewise be correlated with the Maestrichtian because they overlie the E [D-2, see their Correlation chart] zone of early Maestrichtian age and because their outcrop equivalents contain Cretaceous ammonites. If the A-2 zone is equivalent to the Garzas sand as Goudkoff (1945, p. 979) indicates, it may also be assigned to the Cretaceous because of the presence of the mosasaur described by Camp (1942)."

75. TAPPAN, HELEN

Cretaceous biostratigraphy of northern Alaska: Amer. Assoc. Petroleum Geologists, Bull., v. 44, no. 3, pt. 1, p. 273-297, 7 figs., 2 pls.

Similarities of Radiolaria from the Sentinel Hill member (Campanian) of the Upper Cretaceous with those of the Cretaceous of California include "having some very large species, . . . a large number of the Cyrtoidea, in lacking the Spyroidea, and in the abundance of the many-jointed Stichocyrtoidea."

176. TRUJILLO, ERNEST F.

Upper Cretaceous Foraminifera from near Redding, Shasta County, California: Jour. Paleontology, v. 34, no. 2, p. 290-346, pls. 43-50, 3 textfigs. (including geologic map), 2 tables.

"Three Late Cretaceous shale units cropping out in the northern Great Valley have been sampled for foraminiferal content. Approximately 2500 feet of section is represented in association with 1500 feet of sandstone. Ninety species of Foraminifera—twenty-two of which are new—are illustrated, described and their stratigraphic ranges determined. One new name is proposed. Two distinctive faunas are recognizable, the division coinciding approximately with the Turonian-Senonian boundary. Arenaceous species constitute the greater number of individuals; while for stratigraphic purposes the Orbulinidae —especially the genus *Globotruncana*—are dominant in the Turonian and they, with the Rotaliidae, are of greatest importance in the Senonian. Most of the species have been previously reported from the European and Gulf Coastal regions. An interpretation of the paleocology indicates a sublittoral zone as the site of deposition for associated sediments. On the basis of foraminifers and diagnostic megafossils, the ages of the units are determined as Middle Turonian, Coniacian, and Santonian" (Abs.).

The new species are *Cribrostomoides californiensis, Lenticulina californiensis, Lingulina californiensis, L. lucillea, Saracenaria cowcreekensis, Vaginulinopsis reddingensis, Frondicularia durrelli, Marginulinopsis praetschoppi, Marginulina loisana, Valvulineria marianosi, Eponides bandyi, E. birdi, E. goudkoffi, E. greatvalleyensis, Alabamina jimrothi, Anomalina popenoei, Lamarckina reedana, Praeglobotruncana hansbolli, Rugoglobigerina kingi, R. praechelvetica, Pleurostomella greatvalleyensis,* and *Nodosarella wintereri*, and the new name is *Astacolus polandensis*, for *Cristellaria simplex* Dunikowski, 1879 which is a junior homonym of *C. simplex* d'Orbigny, 1846.

The percentage abundance and stratigraphic range of each of the 90 species are given in Table 1 and the "relationship of the various groups of foraminifers by cumulative percentage graphs and also the total number of specimens and species from each 500 gram sample" are indicated in Table 2. Text fig. 3 shows the characteristic assemblages of Foraminifera and selected diagnostic megafossils in the stratigraphic column. Here 8 foraminiferal species characterize lithologic unit Member VI (of Santonian age), 7 the Member IV unit (Coniacian), and 10 the Member II unit (Turonian).

"There is a distinct difference in the faunal aspects of the Turonian and Senonian stages, reflecting the sharp stratigraphic and faunal break upon which the divisions in Europe were based and which is also present in California. Because of this feature, the European stage names have

been applied rather than the less well known California stage names of Goudkoff (1945)." This latter micropaleontologist (1945, table I and text-fig. 2) "considered Member I to be within the Delevanian stage, equivalent to the Gulf Coast Woodbine Group (Cenomanian), and Members II-VI within the Cachenian stage, equivalent to the Eagle Ford Group (Turonian). This correlation with the Gulf Coast Upper Cretaceous may not have been intended, however, for the Austin Group (Coniacian-Santonian) is not listed in the table and is the true equivalent of Members IV-VI. Members I-III correspond to a threefold div sion of the Turonian."

The author states that Goudkoff's zones (194 table II) are not readily recognized in the Re ding area.

177. TYNAN, E. J.

The Archaeomonadaceae of the Calvert formati (Miocene) of Maryland: Micropaleontology, 6, no. 1, p. 33-39, 1 pl.

The genus *Micrampulla* Hanna, 1927, describ as a diatom from the Upper Cretaceous More shale is considered to be an archaeomonad.

ADDENDA

1909

178. BRANNER, J. C., NEWSOM, J. F., AND ARNOLD, RALPH

Description of the Santa Cruz quadrangle, California: U.S. Geol. Survey., Geol. Atlas, Santa Cruz Folio (no. 163), 11 p., maps.

Limestone concretions in the Chico formation near Stanford University contain "abundant fragments of microscopic marine organisms; but none of them have thus far been identified."

1947

179. NAUSS, A. W.

Cretaceous microfossils of the Vermilion area, Alberta: Jour. Paleontology, v. 21, no. 4, p. 329-343, pls. 48-49.

In comparing *Epistomina fax* n. sp. from the Lea Park shale with *E. "caracolla"* Cushman and Church (1929) from the Upper Cretaceous of California, the writer states that the ventral umbo is especially well developed in the latter species.

1958

180. ZINGULA, R. P.

Cretaceous Foraminifera from the Sacramen Valley, California: Dissertation, Louisiana St University, Baton Rouge, La., 114 p., 9 pls., 1 fi 1 table. (University Microfilms, Ann Arb Michigan—Xerox copy: L. C. Card no. Mis 1528).

Thirty-eight samples from the Horseto (Stage) section along Dry Creek in Teha County have yielded 100 foraminiferal species a subspecies, representing 59 genera. Three gene 45 species, and 3 subspecies are new.

"The presence of certain species of *Rotalipo* indicates that the uppermost part of this secti may be Cenomanian in age rather than late Albi The lower portion is probably Aptian or old although planktonic species are too rare to ma accurate age determinations."

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